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CICLO XXXI

THE INPUT-OUTPUT AND COMPUTABLE GENERAL EQUILIBRIUM MODELLING FOR ENVIRONMENTAL AND ENERGY ISSUES

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ATIF MAQBOOL KHAN

DEDICATIONS

I dedicate this humble effort to my dear parents and well wishers whose love, affection and prayers have been a source of constant encouragement for me

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List of Abbreviations

BU	Bottom-up
CGE	Computable General Equilibrium
IFPRI	International Food Policy Research Institute
I-O	Input-Output
NEMS	National Energy Modelling System
SAM	Social Accounting Matrix
SESAME	System of Economic and Social Accounting Matrices and Extensions
SNA	System of National Accounts
SUT	Supply and Use table
TD	Top-down
WDI	World Development Indicators
WIOD	World Input-Output Database
WWII	World War 2

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1. Nexus of Oil production and Environmental Sustainability for Chinese Economy: IO Based Macro Multiplier Approach

Abstract

The Chinese economy has been the world fastest growing economy by average growth rate of approximately 10% annually until the year 2015. Due to excellent economic growth rate, China started the import of crude oil in 1993 for fulfilling the requirement of the economy. In the mid-2013, domestic oil fields of China adversely damaged due to flood and consequently the oil imports of China drastically increased, and China became the largest importer of oil by surpassing USA. The present study contributes to the literature in achieving the objectives in three ways. First to analyse the linkage analysis (based on Macro Multiplier approach) for Chinese industries; second to identify the convenient structure for energy dominating industries of China; third to quantify the impact of oil price impact on final demand by using time series data and ARDL bound testing approach. The empirical analysis will be carried out by making the use of Macro Multiplier Multisectoral approach on the latest available input-output table constructed for the year 2014, later released in 2016 by WIOD. The mainstream economists criticized the environmental policy recommendation for CO_2 emission reduction, which is based on the principle of trade-off between the CO_2 emission reduction and output reduction for different sectors of the economy. The current study identifies the convenient structure for China to tackle the limitation and recommends one of the appropriate policies for getting both objectives simultaneously.

JEL Classification: O13, P28, P48, Q43

Key Words: Oil Prices; China; Input-Output; Macro Multiplier Analysis

1.1 INTRODUCTION

The current era is based on the green revolution, industrialization, urbanization, and that's why with the passage of time, the demand as well as supply of energy is rapidly increasing. The efficient usage of energy is engine of economic development as well as for growth of any economy (Ayres & Warr, 2010; Kümmel et al., 2010). China is leading country in the world with respect to population as the population of China is estimated at 1.38 billion, (Worldometers). On the other hand, China is also leading in terms of demand side of global energy as the total energy demand of China will be almost double to US requirement till 2040, (International Energy Agency). Chinese economy is a top economy in terms of export and on second position in terms of imports.

Currently, there are two major economic challenges for the Chinese economy. The first challenge for Chinese economy is to reduce income inequality among the population and the second challenge is to attain the sustainable economic growth[1]. As the Chinese economy is growing very rapidly and is depending upon the huge level of energy imports (Crude oil and gas), therefore, the sustainable economic development and growth requires the sustainable supply of energy resources like crude oil and gas. If oil price shock appears in terms of energy related imports both in the form of quantity and price wise, there will be chance of significant impact on the different industrial sectors of the Chinese economy (He et al., 2016).

A severe oil price shock has been seen in the previous three years due to many reasons. The first major reason for this phenomenon is the restoration of oil production in Libya and Iraq. The second reason is the increase in the production of unconventional oil like Shale oil consisting of 5% global oil production. The Third reason is due to weakening global demand, the prices suddenly fell around 44% or $49 per barrel. The Fourth reason is the US dollar has appreciated approximately 8% due to oil price since June 2014. The trade of crude oil is linked with US dollar, so it makes expensive to purchase oil for those oil refineries which are located outside the US and it is further reducing the demand of non-US oil, (See, Baumeister & Kilian, 2016).

This sudden fluctuation in the price of oil has affected many economies of the world, both unfavourably and favourably. Due to low price of oil, the economies of oil exporter countries like (OPEC and Russia) have been damaged and on the other hand, the

[1]http://www.worldbank.org/en/country/china/overview

major oil importer countries like China and India, etc have received the positive impact on their economy, (See, Baffes et al., 2015). Overall the low price is good news for countries except oil exporting countries. (See, Papatulica & Prisecaru, 2016).

Due to increase in industrialization, the demand for energy consumption, like, coal, natural gas and petroleum is increasing day by day, thus leading to an increase in the emission of greenhouse gases. The Kyoto Protocol specifies six types of gases[2], which are responsible for producing these greenhouse gases. The most significant emission producing gas is CO_2, with a share of 70% out of total greenhouse gases. The proportion of methane (CH_4) and nitrous oxide (N_2O) emissions is about 24% and 6% respectively. The impact of CO_2 emission on climate change is an important issue as both developed and developing countries are facing a serious challenge of environmental degradation, (Ahmed et al., 2017).

In the mid-2013, domestic oil fields of China adversely damaged due to flood. The oil imports of China drastically increased, and China became the biggest importer of oil by surpassing USA. At present, 6% per mainstream macroeconomic studies, it is forecasted that due to low oil prices, the global GDP has increased by 0.5% in mid of 2014. There are many reasons of CO_2 emission, although the oil is less responsible of CO_2 emission than coal but still fuel oil is also a major cause of CO_2 emission, (Zhao & Chen, 2014). China is also the biggest CO_2 emitter (29% of total emission) and Chinese planners set the target in 12th Five-year plan to reduce the CO_2 emission 40%-45% till 2020 with respect to level of 2005, (Zhao & Chen, 2014).

The current study has used the latest available I-O table of year 2014, later released in November 2016 by WIOD. The limitation of traditional Leontief multipliers has fixed structure of final demand to overcome this limitation, the current study will follow the Macro Multiplier (MM) approach for theoretical and empirical analysis, proposed by (Ciaschini & Socci, 2006). There are following advantages of MM approach, the first advantage of MM approach is to find out the appropriate set of ‘endogenous’ policy profiles. The second advantage of MM approach is to interlink the different economic interaction with macroeconomic variables, which are even active or non-active, (Ciaschini et al., 2010). The third advantage of MM approach is to depict the comprehensive picture of economy by using the macro variables, which is missed by the traditional approaches

[2]Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydro fluorocarbons (HFCs), per fluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

(impact analysis, etc.). The fourth advantage of MM approach is a powerful tool to identify the most appropriate structure of exogenous variable (final demand) and further its impact on total output due to any shock in the economy (Ciaschini & Socci, 2006). The fifth advantage of MM approach is to overcome the traditional limitation of unrealistic structure of exogenous shock by using the traditional multiplier analysis (Ciaschini et al. 2009).MM approach is based on the Singular Value Decomposition (SVD) method; the more details of MM approach is explained in methodology section (1.3.4). On the other hand, the study has adopted the Autoregressive Distributed Lagged (ARDL) model for the estimation of final demand. The ARDL Bounds test system has many advantages on other Co-integration tests, so most of the researchers adopt this technique to check the long run relationship. First, Mainly ARDL approach cannot involve pre-testing procedure. It shows that the test can be applied without worrying about order of integration. Even the mixture of both series (level and 1st difference) can also be tested. So, ARDL can be used efficiently without same order of integration. Second, ARDL approach is stronger and can produce better performance even the sample sizes are undersized. Third, if there is confusion in stationarity-nature of the data, then ARDL is helpful technique. Fourth, ARDL technique has some preferences over other methods such as selection of endogenous and exogenous variables, order of VAR, best possible lags, and dummy variables etc.,(Pahlavani et al., 2005);(Pesaran et al.,2001).Fifth, dummy variables can also be incorporated in ARDL Co-integration test method, (Pesaran et al., 2001).The more details of ARDL approach is explained in methodology section (1.3.5).

The Subsection 1.2.1 provides a detailed overview of Chinese oil sector. Subsection 1.2.2 explains the global oil price and its economic impacts. Subsection 1.3.1 represents the multisectoral methodology for oil Sectors. Subsection 1.3.2 represents the IO Model and Macro Multiplier approach. Subsection 1.3.3 represents the Dispersion analysis. Subsection 1.3.4 explanation of mathematical model of MM approach. Subsection 1.3.5 explains ARDL Bound Testing Approach. Section 1.4 represents the data sources and variables description. Section 1.5 explains the empirical results of ARDL bound model, Section 1.6 discusses the empirical results of Dispersion approach. Section 1.7 depicts the empirical results of MM approach and the last section concludes the paper.

1.2 LITERATURE REVIEW

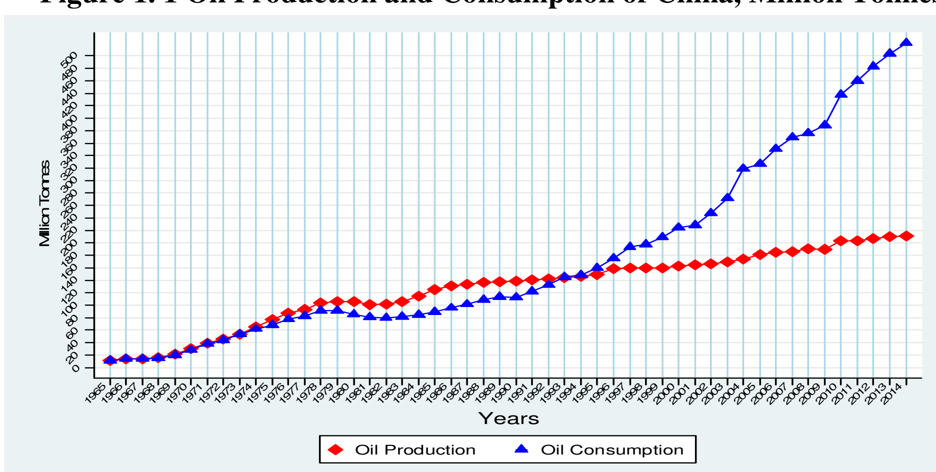
1.2.1 Overview of Chinese Oil Sector

Global oil consumption grew 1.9 million barrels per day (b/d) or (+1.9%) in 2016, which surpassed 1.1 million barrels per day (b/d) or (+1%) observed in 2014. On the other hand, Global oil production has increased more rapidly than the consumption in last two consecutive years, increasing by 2.8 million b/d or 3.2%, the strongest growth since 2004[3].

The oil consumption of China (including the Hong Kong) has increased from 6.9 million b/d in 2004 to 11.9 million b/d in 2015 (12.9% of global oil demand)[4]. Similarly, China has surpassed USA as world largest importer of net oil in 2013. The demand of oil of China has been raised at 8% per year in 2015. The growth rate has gone down at 6.8% in 2016 but import of oil is at highest level in the past 5 years, (Papatulica & Prisecaru, 2016).

The figure 1.1 below shows that both production and consumption (Million tonnes) has been increasing from the year 1965 to 2014. The graph indicates that the oil production and consumption were approximately same from year 1965 to 1974 and from 1993 to 1994 but after 1996 the oil consumption of China has increased rapidly. The oil consumption increased more rapidly than production from 1994 to 2014, which is associated with tremendous record economic growth of China (fluctuating around 8% to 10% averagely).

Figure 1. 1 Oil Production and Consumption of China, Million Tonnes



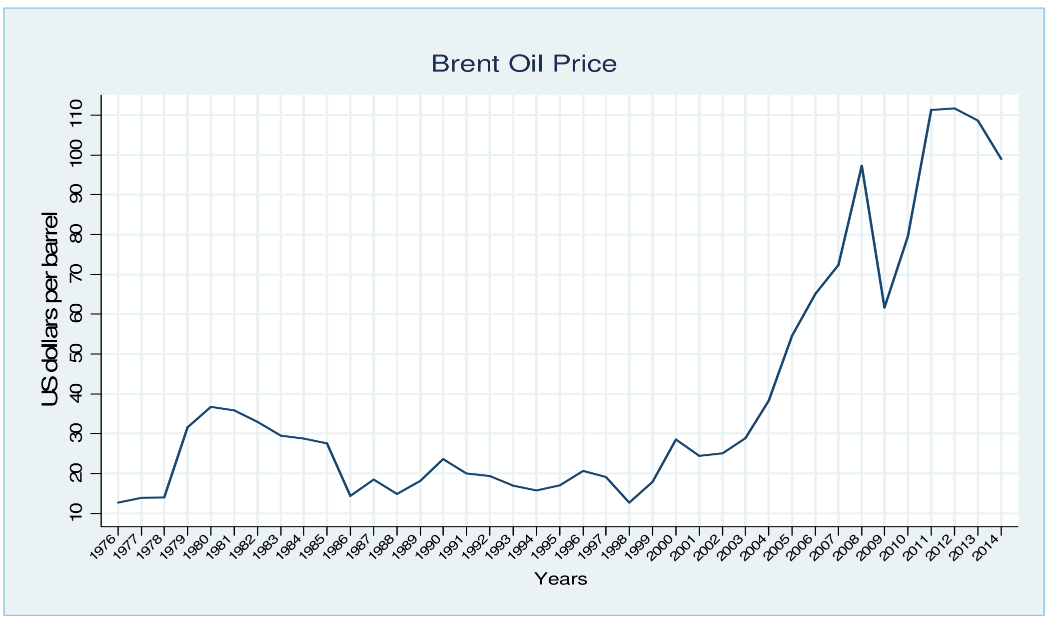
Source: Data for Oil consumption and production taken from BP Statistical Review of World Energy (2016)

[3] BP Statistical Review of World Energy (2016), 3.

[4] BP Statistical Review of World Energy (2016), 9.

The figure 1.2 depicts the huge fluctuations of Brent oil in International market from year 1976 to 2014, especially severe up and downs have been observed from the years 2008 to 2010. The graph indicates that the oil prices have increased from less than $15 per barrel to approximately $97 per barrel in 2008 but after the 2008 global economic crises the oil price has suddenly gone downward. From the year 2009, the oil price gained the upward trend from $97 to $112 per barrel but with received the downward shock from 2008 to 2011. On the other hand, in the period between June and December 2014 due to restoration of oil production in Iraq and Libya; increase in the production of unconventional oil (Shale oil consisting of 5% global oil production) and the weakened global demand, the prices suddenly fell around 44%.

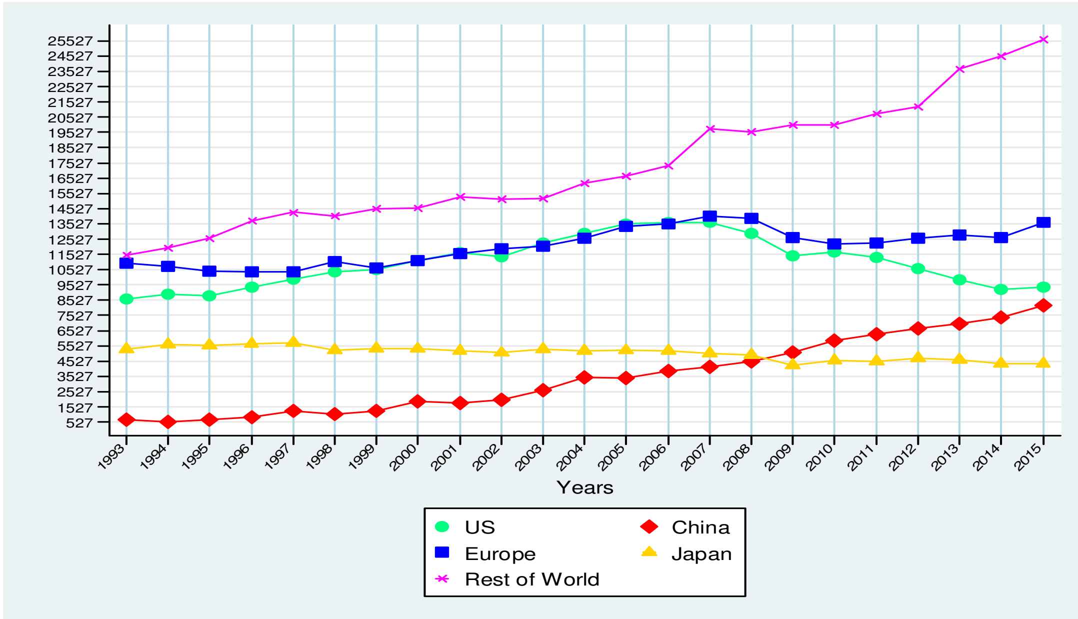
Figure 1. 2 Oil Prices in International Market from 1976 to 2014



Source: Data for Oil price has been taken from BP Statistical Review of World Energy (2016)

The figure 1.3 depicts the graphical presentation of major oil importers from year 1993 to 2014. Overall, positive trend of oil imports has been observed from 1993 to 2014. The red line of Chinese oil imports indicate that the imports have increased from 1,000 to 8,000 thousand barrels daily from 1993 to 2015 respectively and China has surpassed the Japanese oil imports in year 2008.

Figure 1. 3 Major Oil Imports in International Market from 1993 to 2014



Source: Data for Oil price taken from BP Statistical Review of World Energy (2016)

There are three main objectives of current study. The first objective of current study is to check the relevance (identification of key industries) of oil price shock on the different industrial activities of China by using the Macro Multiplier approach for year 2014. The second objective of study is to quantify the impact on demand of oil due to fluctuations in the oil price and to see, what the impact of this expected change in final demand on the other industrial sectors of the Chinese economy is. The third objective of study is to identify the convenient (either one structure or combination of structure is better) structure of policy target (output) and policy control (final demand), where oil commodity reduction and output increase are compatible.

1.2.2 Global Oil price and its Economic Impact

The seminal study of (Hamilton,1983) suggested that the shock in oil prices is main reason for recession in the economy and nine out of ten recessions have been seen due to oil price shocks since the World War II. After the Hamilton's study, many studies have tried to explore the relationship between the oil price shock and economic activities across the different countries, i.e.; (Burbidge & Harrison, 1984; Gisser & Godwin, 1986; Mork et al., 1994; Lee & Ratti, 1995; Lee et al., 2001; Brown & Yücel, 2002; Chang & Wong, 2003; Cuñado & Gracia, 2005; Hamilton,1996, 2003, 2005 & 2009; Cologni & Manera, 2008;

Lorde et al., 2009; Doğrul & Soytas, 2010; Rasmussen & Roitman, 2011; Peersman & Van Robays, 2012; Mohaddes & Raissi, 2015; Mohaddes & Pesaran, 2016).

There are mainly three types of studies done by the researchers about the relationship between the oil price shock and economic activities. The first type of study analysed that what would be the theoretical mechanism between the economic activities and increase in oil prices, (Bruno & Sachs, 1982; Hooker, 1996; Hamilton, 1996; Brown & Yücel, 2002). The second type of study has investigated the empirical relationship between oil price fluctuation and aggregate level of economic activity. Most of the studies investigated the developed countries by using the data sets between 1970s to 1990s, (Lee et al., 2001; Lee & Ni, 2002; Cuñado & Gracia, 2003; Leduc & Sill, 2004; Lardic & Mignon, 2006). The third type of study has mainly focused on tackling the problem of oil price shock by using the tool of macroeconomic policies, (Huang et al., 2005; Cologni & Manera, 2008).

Most of the previous studies analysed the oil price shock under the context of increase in the oil price effect on the economic activities. The foremost result of studies depicts that due to increase in the oil prices, the output decreases, and the incidence of inflation arises. Therefore, due to above said problems (low output and high inflation), the studies recommended some solid monetary policies to tackle the problems and to stabilize their economies (e.g., Hamilton 1983 & 2003; Burbidge & Harrison, 1984; Gisser & Goodwin, 1986; Daniel, 1997; Carruth et al., 1998; Cologni & Manera, 2008; Kilian, 2009 & Katayama, 2013).

The study of (Brown & Yücel, 2002) mentioned six transmission channels between the oil price shock and macroeconomic variables performance. The first channel explains the supply-side shock effect: there is direct impact of oil price shock on the marginal cost of production; Second channel is based on the Wealth transfer effect: focusing on the different marginal consumption rate of petrodollar and that of ordinary trade surplus; Third channel is based on Inflation effect: investigation between the oil price shock and domestic inflation rate; Fourth channel is based on Real balance effect: analysing the relationship between the demand of money and its impact on monetary policy; Fifth channel is based on sector adjustment effect: finding out the adjustment cost of industrial structure; Sixth channel is based on unexpected effect: concentrating the uncertain factor about oil price and its ultimate impact on the economy.

Hamilton (2003) reported the historical view of oil shock impact on the output and analysed that due to oil peak, there will be 10% reduction in total output. According to historical observation there has been reduction of world oil and gas on output during past oil shocks, e.g., 10.1% reduction at Suez crisis (1956); 7.8% during Arab–Israel war (1973);8.9% during Iranian Revolution (1978); 7.2% during Iran–Iraq war (1980) and 8.8% during Persian Gulf war (1990).

There are several points of view for 2014 oil price shock on oil importing countries. The study of Baffes et al. (2015) analysed that the oil importing countries should attain the benefit due to recent low oil prices. The income of household as well as corporations will be increased due to low oil prices. The analysis of (Baumeister & Kilian, 2016) suggested that demand factors are more influential in capturing the behaviour of oil prices, while the (Baffes et al., 2015; Husain et al., 2015; Mănescu & Nuño, 2015) argue that supply (rather than demand) factors played the crucial role.

In the context of China, (Huang & Feng, 2007) examined the impact of oil price shock on the real exchange rate for China. (Faria et al., 2009) observed the causes behind the rapid fluctuations in exports pattern due to oil price shocks. (Du et al., 2010) examined the Chinese economy by using the VAR model and reported that there is positive correlation between the world oil price and GDP growth of China. The study also noted that oil price shocks has significantly influence the domestic inflation. The studies like (Liu & Ren, 2006; Kerschner & Hubacek, 2009) used input output tables and measured the inter-industries linkages, direct and indirect effects of oil-price shocks. The investigation of (Kerschner & Hubacek, 2009) analyzed the results in terms of final demand for net-oil exporting and net-oil importing countries and found that the industries like transportation, electricity production and financial and trade services are most affected. (Wu et al., 2013) examined that the Chinese economy is overly sensitive with respect to oil price shocks. (Zhang & Chen, 2014) find out that due to both expected and unexpected oil price volatilities, the aggregate commodity market in China is affected and there is severe impact of unexpected oil volatilities after 2007. Many studies have done research on the topic of price fluctuations and its economic impact on different countries by using several techniques but very few studies are available on China (Zhang & Chen, 2014; Wu et al., 2013; Du et al., 2010; Faria et al., 2009, and Huang & Feng, 2007). The earlier studies used the conventional methodologies like Impact analysis by using the traditional Leontief multipliers, which is based on fixed structure of final demand to overcome this limitation, the current study will follow the Macro Multiplier (MM) approach for theoretical and empirical analysis, proposed by (Ciaschini & Socci, 2006). The current study is using the latest data set of I-O, 2014, it would be significantly impact in recent literature.

1.3 METHODOLOGY

1.3.1 Multi-Sectoral Methodology for Oil Sector

This section presents the methodological explanation of current study, including the background of I-O, MM approach and their relationship with final demand and output. On the other hand, the second part of study is based on ARDL Bound Testing Approach for estimating the final demand and to capture the impact of oil price shock on final demand.

The current study is investigating the multi-industry analysis by using the MM approach. The general concept of I-O multipliers is to describe that what would be impact on all existing industries of the economy due to any shock in the demand for output of any industry. This type of multiplier effect presents only average effects and ignores the marginal effects, changes in technology, economies of scale and unused capacity in the economy.

The derivation of multipliers is based on fixed year I-O table of any specific country, so it is hard to find the latest data sets for every year. That's why most of the study used the previous years based I-O tables. Therefore, the technological development is not so rapid that's why the estimated results are showing appropriate picture of the economy. In most of the cases, the results of multipliers are stable except that of very rapid price fluctuations in international markets, especially the energy related products. In Input-output model, the factors like primary inputs (labour and capital factors) are less stagnant. There are also some limitations of multipliers, as generally multipliers are based on unrealistic assumptions like supply constraint (no change in labour, land, capital, goods and services, etc).

The standard I-O multipliers are based on demand-side I-O models. The demand-side model estimates the demand for its outputs. There are many types of multipliers derived from the I-O tables, depending upon the requirement of the economic analysis. The most prominent derivation of multiplier is Output Multipliers. The output multiplier for an industry, say Construction, is defined as the total value of production by all industries of the economy required to satisfy one extra dollar's worth of final demand for that industry's output. That's why the change in production of all industries in the economy could be measured, rather than the increase in value added of all industries (which corresponds to the increase in gross domestic product).

1.3.2 IO Model and Macro Multiplier approach

In the linkage analysis, Multipliers are widely used to capture the direct as well as indirect final demand shocks on important economic variable like production and value added. Generally, the use of demand multipliers has serious limitation, such as unitary shock in specific sector and zero elsewhere in the case of backward multipliers and on the other hand a unitary shock in all sectors at once in the case of forward multipliers. This limitation is making useless to adopt the Rasmussen Multipliers. The traditional Leontief and Rasmussen multipliers are unable to compare the impacts of changes on output (value added, employment, or energy consumption, etc.), (Do Amaral et al., 2012).

The equation [1] represents the relationship between the output (x) and final demand (f), **f** represents the final demand (including consumption, investment, Government expenditure and exports) vector.

$$x = R.f \qquad [1]$$

The term **R** in the above equation [1] represents the Leontief inverse matrix,

1.3.3 Dispersion Approach

From equation [1], we have the structural matrix R which helps quantify the direct and indirect effects of final demand on total output.

$$R = [I-A]^{-1} \qquad [2]$$

By using the R matrix, we can analyze the direct as well as indirect linkages effects by adopting the (Rasmussen, 1956) method. The significant literature on linkages analysis has been investigated by the studies like (Rasmussen, 1956); (Chenery & Watanabe, 1958); (Jones, 1976); (Cella, 1984); (Clements, 1990); (Dietzenbacher, 1992) and many more. The forward and backward linkages also called the index of sensitivity of dispersion and power of dispersion index respectively, (Ciaschini & Socci, 2007; Dettmer & Fricke, 2014).

There are two types of linkages explained by (Miller & Bliar, 2009). First, if sector $\boldsymbol{i}$ increases its output then the demand of other sectors in the economy will be increased, whose products are used as an input for their production of $\boldsymbol{i}$ sector, this type of demand relationship is called backward linkages. On the other hand, the increase in the output of $\boldsymbol{i}$ sector means that additional amount of product $\boldsymbol{i}$ is available as an input for the production of other sector of the economy; this type of supply relationship is called forward linkages. Therefore, the significant of linkage analysis is supportive to identify the most important sectors in the economy, which is based on the strengths and weakness of linkages. The total backward linkages of sector j are the sum of columns of Leontief inverse **L**, (Miller & Blair, 2009). For better comparison of sectoral backward linkages, the normalization is important, (Miller & Blair, 2009). The backward linkages reflect the effects of increase in final demand of sector j on overall output. The backward linkage is representing that how one sector used the input of other sector of the economy. If the larger the value of sector, the greater dependence of input of other sector of the economy and therefore represent the greater amount of stimulation in the economy due to increase in the output of the economy, (Aroca, 2001).

The dispersion index method has been adopted from (Ciaschini et al., 2009). The power of dispersion index can be expressed as:

$$\pi_j = \frac{\frac{1}{m.r_j}}{\frac{1}{m^2}.\sum_{j=1}^{m} r_j} \qquad [3]$$

The term m is standing for the no of commodities. The term $\sum_{j=1}^{m} r_j$ denoting the sum of all backward linkages.

The total forward linkages of sector i are the sum of rows of Leontief inverse L, (Miller & Blair, 2009). The term $\sum_{i=1}^{m} r_i$ denoting the sum of all forward linkages. The (Rasmussen, 1956) forward linkage (sensitivity index) shows the one monetary unit increase in the value of the primary inputs of sector i would affect the value of output produced by all the other sectors in the economy. The sensitivity of dispersion index can be expressed as:

$$\pi_i = \frac{\frac{1}{m.r_i}}{\frac{1}{m^2}.\sum_{i=1}^{m} r_i} \qquad [4]$$

Where **A** is a matrix of constant technical coefficients, **A** should be must satisfy the Hawkins-Simon[5] conditions, when the technological factor is working as a part of output to fulfill the requirement of intermediate transaction among the industries and after this still available for the final usage. The term **I** represents the identity matrix and usually in the

[5] Hawkins & Simon (1949), proposed the Hawkin-Simon Theorem, the main crux of theorem is that to insure the non-negative output vector in the IO model, where demand will be equal to supply. In other words, if the principle minors of (I-A) are all positives, its known as Hawkin-Simon conditions.

literature the term **R** represents the Leontief inverse matrix or Multiplier matrix, (Duchin & Steenge, 2007).

The equation [5] represents the intersectoral relationship between the policy control variable (Final demand) and total output (X). The equation indicated the impact of change in final demand (ΔF) and change in total output (ΔX), is depicted as in equation [5]:

$$\Delta x = [I-A]^{-1}\Delta f \qquad [5]$$

1.3.4 IO based Macro Multiplier approach: relationship between final demand and output

The **R** matrix can be decomposed into several sums of **m** matrices by adopting the approach of Singular Value Decomposition (SVD), (Ciaschini et al., 2006). The approach of singular value decomposition can be applied on both square and non-square matrices. The present study adopted the version of square matrix for SVD technique. Simply, by using the 2x2 matrix of **W [2,2]**. The matrix **W** is consisted on the multiple combination of matrix **R** and transpose of **R** matrix.

$$W = R^T R \qquad [6]$$

In equation [6], the Matrix **W** is based on positive definite (symmetric matrix with all positive eigenvalues), or semi definite square root. Therefore, the matrix **W** ≥ 0 with all real non-negative eigenvalues λ_i for i = 1, 2, (Lancaster & Tiesmenetsky, 1985). The eigenvectors for **W** and $\mathbf{W^T}$ are respectively [u_i i = 1, 2] and [v_i i = 1, 2] are based on orthonormal. We have

$$R^T . u_i = \sqrt{\lambda_i} v_i \qquad [7] \qquad i = 1,2$$

The eigenvectors **U** and **V** for matrixes **W** and $\mathbf{W^T}$ may be constructed as

$$U = [u_1, u_2] \qquad [8] \text{ and } V = [v_1, v_2] \qquad [9]$$

Under the above said definition, the eigenvalues for matrix **W** coincide with singular values of matrix **R**, so $s_i = \sqrt{\lambda_i}$ and we attain the following matrices.

$$R^T . U = [s_1 . v_1, s_2 . v_2] = V . S \qquad [10]$$

The Structural Matrix **R** in equation [1] may be decomposed as

$$x = U . S . V^T . f \qquad [11]$$

The term V is [2, 2] unitary matrix, whose columns define the two reference structures for final demand:

$$v_1 = [v_{1,1} v_{1,2}] \qquad [12] \quad \text{and} \quad v_2 = [v_{2,1} v_{2,2}] \qquad [13]$$

U is an [2, 2] unitary matrix, whose columns define two reference structures for output:

$u_1 = \begin{bmatrix} u_{1,1} \\ u_{2,1} \end{bmatrix}$ [14] and $u_2 = \begin{bmatrix} u_{2,1} \\ u_{2,2} \end{bmatrix}$ [15]

Similarly, the term S is an [2, 2] diagonal matrix of the type:

$$S=\begin{bmatrix} s_1 & 0 \\ 0 & s_2 \end{bmatrix} \qquad [16]$$

The scalars Si mentioned in equation [16] are all real and positive and can be ordered as $s_1 > s_2$. The set of equations from [1] to [16] are enough to fulfill the construction and decomposition of MM that quantify the aggregate effect of any fluctuation in the final demand on output. The vector **f** given in equation [17] may be expressed in terms of structures identified by matrix **V**, we get new final demand vector $\mathbf{f^0}$ that is characterized in terms of the structures explained by matrix R:

$$f^0 = \mathrm{V.f} \qquad [17]$$

Therefore, the total output **x** can be expressed under the given structure of matrix **R**:

$$x^0 = \mathrm{U}^T . x \qquad [18]$$

By putting the values of equation [17] and [18], the equation [11] can be expressed as

$$x^0 = \mathrm{S.f}^0 \qquad [19]$$

Which implies,

$$x_i{}^0 = s_i . f_i^0 \qquad [20]\ i = 1,2$$

The matrix **R** also consisted on two hidden essential combinations of output (x). Hence, each of combination has been derived out by multiplying the respective combination of final demand (F) by a predetermined scalar, which plays significant role in the aggregation process of macro multiplier (MM). The equation [20] showed that by multiplying the term s_i, the complex effect on the output vector of final demand can be reduced.

The above said structure has well designed all potential behavior of system and all shocks can be captured by this method. The MM approach easily captured all the effect of final demand on output in whole economic structure. The convenient way to capture the impact of final demand on output through MM approach is by organizing the equation [11] in such a way, supposed the vector **f** is any constant, say equal to one. So, vector f in equation [11] can be described as:

$$\sqrt{\sum_j f_j^2} = 1 \qquad [21]$$

Equation [21] implies that the final demand vector depicts a sphere of unit radius, being the unit circle. The ellipsoid shape shows the change in output effected by the final demand.

$$f^{*}=\alpha+v_1 + (1\text{-}\alpha)v_2 \qquad [22],\ (0 \le \alpha \le 1)$$

Its effect on total output will be showing same combination,

$$x^{*}=\alpha[s_1 u_1] + (1\text{-}\alpha)[s_2 u_2] \qquad [23]$$

1.3.5 ARDL Bound Testing Approach for estimating the Final Demand

This section is based on the ARDL Bound Testing Approach for estimating the explanatory variables on final demand by using the Auto metrics approach, (Castle et al., 2011). The automatic selection procedure is based on "General to Simple Approach". In this approach, the selection of model is based on significant variables and the non-significant variables are excluded automatically. The most important advantage of automatic model selection procedure is to tackle well in the case of limited no of observations. The current model is autoregressive model with explanatory variables oil price (OP) and real interest rate[6] (RIR) by using the time series data from 2000 to 2014. The main limitation of the model is limited availability of data set because the data for final demand has been extracted from the WIOD input-output data sets (available from 2000 to 2014). The actual model is estimated by regressing the final demand on the lag of final demand (FD) among other explanatory variables with their lags, but the automatic selection procedure excludes the non-significant lag values of (OP) and (RIR) from the model. By running the several regression models, the decision of model given below in equation [17] is based on fulfilling the diagnostic tests (especially the non-existence of serial correlation). The following Econometrical model has been selected by adopting the automatic model selection procedure:

$$FD_t = f(FD_{t-1}, OP_t, RIR_t) \qquad [24]$$

Co-integration means the LR relationship between non-stationary time series. Suppose there are two series A and B, which are individually non-stationary on first difference but after taking the linear combination of both series, it becomes stationary on I (0). In other words, we can say that any two variables are said to be co-integrated if they

[6]The importance of real interests is that it incorporated the inflation impact, it gives better signals to consumers and investors.

have long term stability or relationship among them, (See, Gujarati, 2004).

There are different econometrics methodologies have been used to check the co-integration relationship between variables like, Co-integrating Regression Durbin-Watson (CRDW) test proposed by (Engle & Granger, 1987); Co-integration test proposed by (Johansen & Juselius, 1990) and Cointegration test proposed by (Phillips & Ouliaris, 1990), etc. But every Cointegration test has some limitations, so, (Pesaran et al., 2001) proposed ARDL Bound testing approach due to its characteristics over other Cointegration test.

In this section, a quite new method "ARDL Bound testing" approach has been adopted, which is set up on the past studies of (Pesaran & Shin, 2002) and (Pesaran, et al., 2001). This technique is used to take away from complications which appeared as hurdle in selection of unit root tests (Pesaran et al., 2001).

There are three major purpose of using bound testing procedure:

- (Pesaran et al., 2001) suggests that once order of Autoregressive Distributed Lag has been known, the relationship can be estimated by simply applying OLS method.
- The ARDL has no concern by order of integration. This bounds test allows regressors as level stationary or first difference stationary or mixture of both [I (0) and I (1)]. So, in Bound testing approach it is not necessary that order of integration of two series is same.
- This practice is proper for small as well as for series having limited sample size (Pesaran et al., 2001).

1.3.6 The Autoregressive Distributed Lag (ARDL) approach

Equation [24] may be rewritten:

$$\Delta FD_t = \alpha_0 + \sum_{j=1}^{p_1} \alpha_{1j}\Delta FD_{t-j} + \sum_{j=1}^{p_2} \alpha_{2j}\Delta OP_{t-j} + \sum_{j=1}^{p_3} \alpha_{3j}\Delta RIR_{t-j}$$

$$+\omega_1 FD_{t-1} + \omega_2 OP_{t-1} + \omega_3 RIR_{t-1} + \varepsilon_{1t} \quad [25]$$

Where coefficients are $\alpha_0, \alpha_1, \alpha_2$ and α_3, whereas ε_{1t} is the white noise error term or disturbance term. The terms p_1, p_2 and p_3 are the maximum lag length and will be chosen via Schwarz Bayesian Information Criterion (SBIC). Equation [25] is being estimated in 2 steps. The first step is to test the null hypothesis, which is indicating the non-existence of Cointegration (long-run relationship) between the variables, while in second step alternative hypothesis is taken which indicates the presence of Cointegration (long-run relationship) in variables.

1.3.7 Advantages of using the Autoregressive Distributed Lag Approach

The ARDL Bounds test system has many advantages on other Co-integration tests, so most of the researchers adopt this technique to check the long run relationship. These are the advantages which are explained below one by one.

1. Mainly ARDL approach cannot involve pre-testing procedure. It shows that the test can be applied without worrying about order of integration. It is not essential to see that the basic series are purely level stationary, or the series are stationary on first difference. Even the mixture of both series (level and 1st difference) can also be tested. So, ARDL can be used efficiently without same order of integration.

2. The second major advantage to use the ARDL approach is that it is stronger and has better performance even the sample sizes are undersized. It can be applied to single equation model.

3. In time series data the major problem is stationary or unit root problem. If there is confusion in stationarity-nature of the data, then ARDL is helpful technique. If the results are taken by applying Bounds test approach for co-integration, unit root test is unnecessary (Pesaran et al., 2001).

4. Fourthly, ARDL technique has some preferences over other methods as selection of endogenous and exogenous variables, order of VAR, best possible lags, and dummy variables etc. So, in ARDL technique there are many choices (Pahlavani et al., 2005); (Pesaran et al.,2001).

5. A Dummy variable can also be incorporated in ARDL co-integration test method. According to point of view of (Pesaran et al., 2001), the addition of any ''one-zero'' dummy variable cannot affect the asymptotic theory which is later developed in the Autoregressive Distributed Lag.

1.3.8 Research Hypotheses

The null and alternative hypothesis for equation [24] has given below:

H_0: $\kappa_1 = \kappa_2 = \kappa_3 = 0$ (No any presence of Co-integration/ LR relation) is tested alongside the alternative hypothesis of **H_1**:$\kappa_1 \neq 0, \kappa_2 \neq 0, \kappa_3 \neq 0$ (Presence of Co-integration/ LR relation). The null hypotheses will be tested via F-statistic. According to these authors, the lower bound critical values, κ_t is zero integrated order or I (0). On the other side in upper bound critical values, κ_t is integrated of order one or I (1). So, if the lower bound value is greater than calculated value of F-statistic, the null hypothesis is not rejected, and it is indicating the absence of long-run relationship between variables. Further the long-run relationship exists if the upper bound value is smaller than computed F-statistic. Moreover, results are inconclusive if F-statistic lies between the lower and upper bound values.

1.4 DATA SOURCES AND DESCRIPTION OF VARIABLES

In this section, the explanation of data sources and description of variables for China has been explained. The study of (Timmer et al., 2016) mentioned some important features of new WIOTs released by WIOD. The Input-output tables published by WIOTs are mostly based on the data sources like OECD and UN National Accounts. The latest Input-output tables are released in November 2016 by WIOD. This latest version of data sets is updated form of 2013 WIOD. The methodology and nature of data of tables used in the construction of 2016 WIOTs are same as used in 2013 WIOTs. However, there are several additional improvements that have been incorporated in 2016.

The definition of GDP with respect to expenditure side is equal to aggregate level of consumption (C), investment (I), Government expenditure (G) and net export (Exp-Imp), the equation (A) stands for the GDP approach by Expenditure:

$$GDP_{EXP}=C+I+G+(EXP\text{-}IMP) \qquad [26]$$

The WIOTs sets the C as a private consumption and decompose the consumption into two categories, (1) The final consumption expenditure by households (CONS_h) and (2) Final consumption expenditure by non-profit organizations serving household (CONS_hp). Similarly, WIOTs take Investment (I) or Gross capital formation as gross fixed capital formation (GFCF) plus changes in inventories and valuables (INVEN). The term G stands for the final consumption expenditure by Government (CONS_g). The term (EXP-IMP) denoted the balance of trade.

WIOD classified the GDP with respect to production side as, the equation (B) stands for the production approach of GDP:

$$GDP_{INC}=VA+TXSP \qquad [27]$$

The term VA stands for the total value added (summed of all industries). Similarly, the term TXSP denoted the total of *taxes less subsidies on production* for both intermediate use and final demand. The Input-output (2014) table for China released in year 2016 is based on the (commodity-by-commodity) at a detailed 120+ product level for benchmark years 2002, 2007 are based on CSIC 2002 and year 2012 is based on CSIC 2011 at producer prices and conform SNA 1993. Both sources are published by the National Bureau of

Statistics. In the external data set, data has been accessed from UN (National Accounts) with respect to expenditure from year 2000 to 2014. Similarly, the data sets of output and value added accessed from the *China Industry Productivity* (CIP) database 3.0 from year 2000 to 2010. The data set of CIP is based on 37 Industries ISIC rev. 4.

Table 1. 1 Brief description and Sources of data

S. No	*Variables*	*Descriptive Name*	*Sources*	*Unit*
1.	Final Demand	FD	IO-2014	Million Dollars
2.	Oil Price	OP	BP	US dollar per barrel
3.	Real interest rate	RIR	WDI[7]	Percentage

1.5 EMPIRICAL ANALYSIS OF ARDL BOUND MODEL

The following figure 1.4 writes down the graphical representation of variables used in the Econometrics analysis. The left panel stands for the growth of final demand for China from year 2000 to 2015. A huge fluctuation has been seen in the whole span. On the other hand, the graph of real interest rate also shows the huge fluctuations from year 2000 to 2015. The left and right panel of figure 1.4 depicts that there is inverse fluctuating trend between growth of final demand. The real interest rate has been seen from period 2000 to 2015.

Figure 1. 4 Variables used in Econometrical Analysis

[7] World Development Indicator, 2016

This section stands for the empirical estimation by using Automatic Model selection procedure.

Table 1. 2 Regression results by using Automatic Model Selection procedure

	Coefficient	*Std.Error*	*t-value*	*t-prob*	*Part.R^2*
FD_1	1.02650	0.02855	36.0	0.0000	0.9916
OP	19673.6	3660.	5.38	0.0002	0.7242
RIR	-120660.0	3.255e+004	-3.71	0.0035	0.5555

Table 1. 3 Diagnostic Test Summary

AR 1-1 test:	*F(1,10)*	*= 0.41588 [0.5335]*
ARCH 1-1 test:	F (1,9)	= 0.11341 [0.7440]
Normality test:	Chi^2(2)	= 0.86251 [0.6497]
Hetero test:	F (6,4)	= 0.41920 [0.8365]
RESET test:	F (1,10)	= 1.0157 [0.3373]

Final Model:

FD = + 1.027*FD_1 + 1.967e+004*OP - 1.207e+005*RIR [28]

(SE) (0.0285) (3.66e+003) (3.25e+004)

By using the above estimated model [28], the estimated value of aggregate final demand for year 2014 is 22,432,841.27 million dollars. The estimated model has been selected by using the automatic model choice procedure by using the OxMetrics. The estimated absolute t-value and p-value shows that all the selected explanatory variables are highly significant on 1% and 5% significance level. Similarly, the diagnostic tests show that tests corroborate the validity of hypothesis. Specially, the serial correlation problem is not existing here, which is usually the main issue in the time series data. The RESET test also suggests that the model specification is good.

The main objective of above regression result is to capture the oil price (OP) impact on final demand (FD). Therefore, the results show significant impact of oil price (OP) on (FD). The result shows that on average if the (OP) increases 1 US dollar per barrel then the final demand (FD) will be increased to 19,673.6 million dollars in the Chinese economy and vice versa.

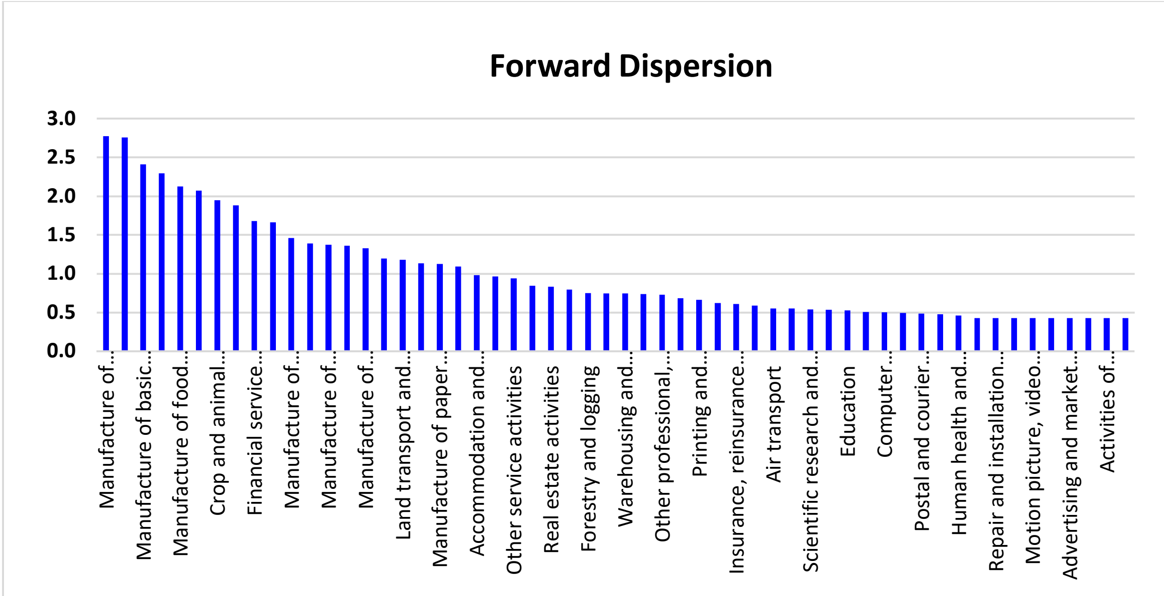
1.6 EMPIRICAL ANALYSIS OF DISPERSION APPROACH

The figure 1.5 depicts the index of sensitivity dispersion with respect to commodities arranged according to their corresponding rankings (descending to ascending order). The commodity like 'Manufacture of chemicals and chemical products ' is showing the highest ranked with the index of 6.45, similarly the 'Mining and quarrying' with index value 6.41 (rank 2); 'Manufacture of basic metals' with index value 5.61 (rank 3); 'Electricity, gas, steam and air conditioning supply' with index value 5.34 (rank 4); 'Manufacture of food products, beverages and tobacco products' with index value 4.94 (rank 5); 'Manufacture of coke and refined petroleum products' with index value 4.83 (rank 6); 'Crop and animal production, hunting and related service activities' with index value 4.5 (rank 7); 'Wholesale trade, except of motor vehicles and motorcycles' with index value 4.38 (rank 8) and the rest of rank index values are portrayed in appendix A-II (table 1.5).

All ranks, which have higher index value than 1 shows the strong forward linkages. The unity value stands for the average index value. There is not any evidence of weak forward linkages because all index values are higher than equal to 1. The both energy-oriented industries like 'Mining and quarrying' and 'Manufacture of coke and refined petroleum products are included in the Key[8] or leading industries in Chinese economy by having strong forward dispersion (FD>1) with the index values 2.8 and 2.1 respectively. The detail results are portrayed in appendix A-II (table 1.5).

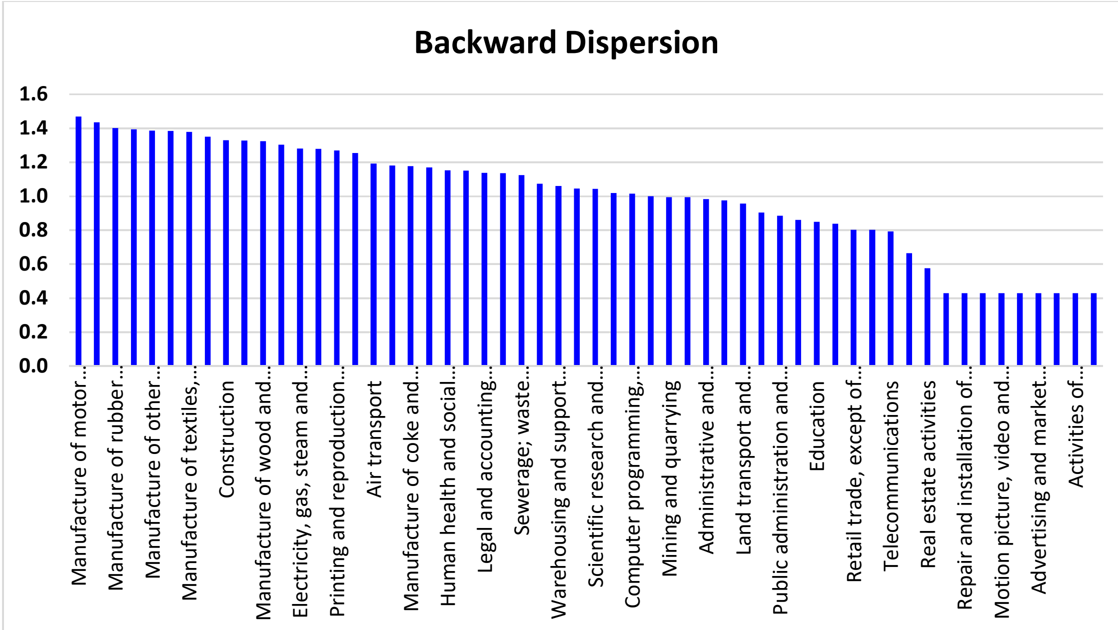
[8]Usually in the literature of Linkage analysis, the meaning of key industries is that the industries are fulfilling the condition of (BD>1, FD>1). (See, Cai et al., 2006).

Figure 1. 5 Forward Dispersion with respect to Ranks



The figure 1.6 depicts the index of power of dispersion with respect to commodities arranged according to their corresponding rankings (descending to ascending order). The commodity like 'Manufacture of motor vehicles, trailers and semi-trailers' is showing the highest ranked with the index of 1.5, in short, the index values from rank 1 to 27 represents strong backward linkages having because the index values are greater than 1. The rest of all commodities from rank 38 to 56 index values are less than 1, which shows the weak backward linkages. The unity value stands for the average index value. The both energy-oriented industries like 'Mining and quarrying' and 'Manufacture of coke and refined petroleum products are included in the Key industries in Chinese economy by having strong backward dispersion (BD>1) with the index values 1.4, the detail results are portrayed in appendix A-II (table 1.5).

Figure 1. 6 Backward Dispersion with respect to Ranks



Both energy-oriented industries are fulfilling the condition of key industries (FD>1, BD>1) and can play important role in the development of Chinese economy and can further boost the other industries. The results of current study are consistent with the previous study like (San Cristobal & Biezma, 2006).

1.7 EMPIRICAL ANALYSIS OF MACRO MULTIPLIER APPROACH

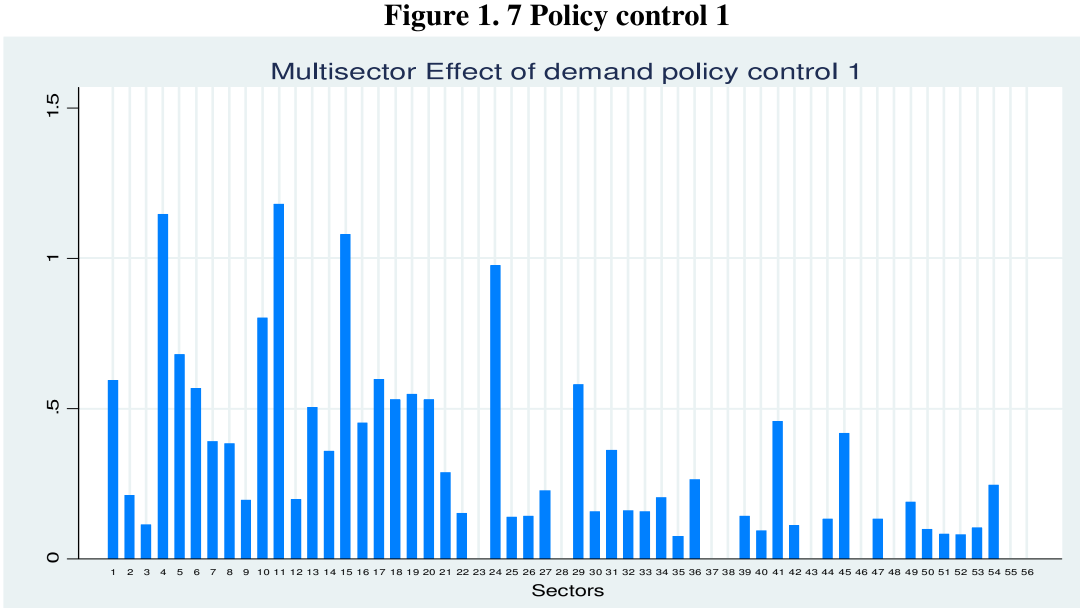
The policy variables (change in final demand) has been based on 56 independent demand sectors and connected with the objective variable (total change in output). By adopting the SVD technique, we have obtained the set of 56 singular values, also known as macro multipliers (MM), (Si), which is further related with linearly independent set of 56 control variables (matrix V) and target variables (matrix U). The values of MMs portrayed in appendix A-IV (table 1.6), therefore the value of s_1 (MM1) is most dominating values with (3.208). The higher value of s_1 (3.208) implies that due to shock in final demand vector there would appear (3.208) times change in total output vector. Similarly, the values of MM in table appendix A-IV (table 1.6) shows that MM froms_2 to s_{34} amplify the effect of the shock, while the MM from s_{43} to s_{56} reduces the effect and the s_{35} and s_{43} are not generating any effect from final demand vector to output vector.

The MM with respect to different industries has been portrayed in appendix A-III (Figure 1.10), which shows that S is moving in descending to ascending (higher to lower) trend, which is consistent with the theory. The s_1 (A01 industries) and s_{56} (U industries) represents the higher and lower MM, respectively. The detail description of Chinese industries has been given in appendix A-I (table 1.4).

By analysing the Policy 1, characterized by modulus-multiplier s_1, by a demand-control structure v_1 and by an overall policy effect on the objective, $s_1 \cdot u_1$ has been portrayed in the second column of appendix A-V (table 1.7). It can be seen at row 4 wherein the most relevant component is 1.146, which shows that a demand control tends to have the greatest impact on industry 4 the *Mining and quarrying*. Similarly, policy 1 is also the most convenient in the case of industry 10 the *Manufacture of coke and refined petroleum products*. The result has been shown in row 10 that is the most relevant component with 0.803, which shows highest impact with respect to demand control. There is inverse relationship between the results of industry 10 and 4 with respect to policy recommendation for environmental issues (CO_2 emission reduction). As the structures like $s_{1.}u_1$ and $s_{10.}u_{10}$ are weak structures and both structures are individually not convenient for whole economic growth and environmental policy (CO_2 emission reduction), so the current study adopted the combination of both mentioned weak structures and developed the strong structure, mentioned in the Column 4 and 8 in appendix A-V (table 1.7). The combination of structure with the weights α=0.1 and 1-α=0.9 is convenient for getting both objectives, enhancing the production (output change) and reducing the CO_2 emission.

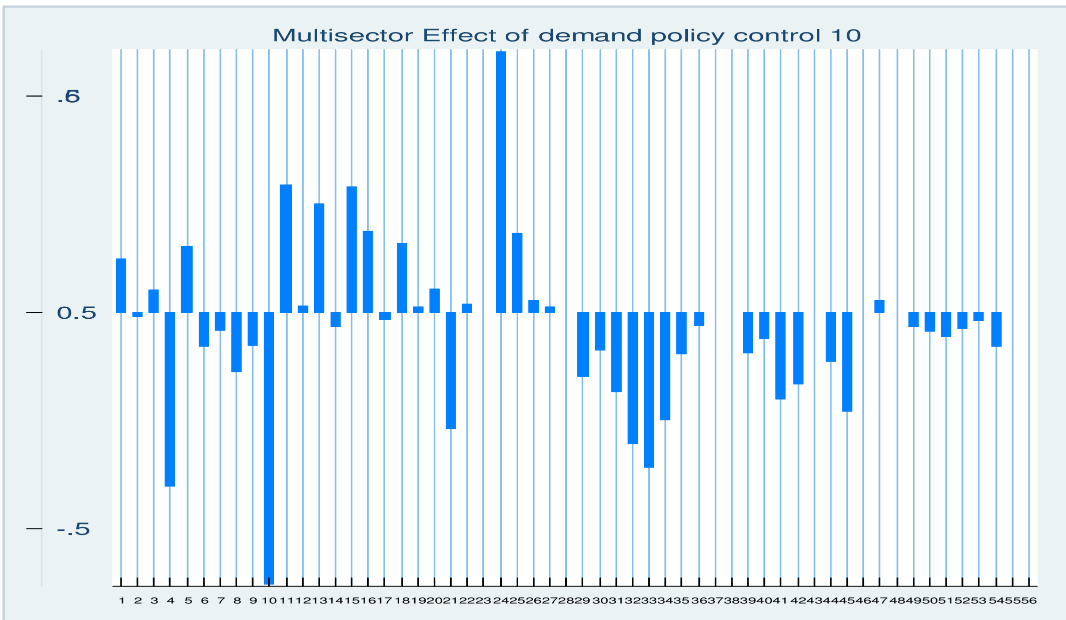
The figure 1.7 represents the convenient policy for (change in output) but it is not convenient for above said environmental policy.

Figure 1. 7 Policy control 1



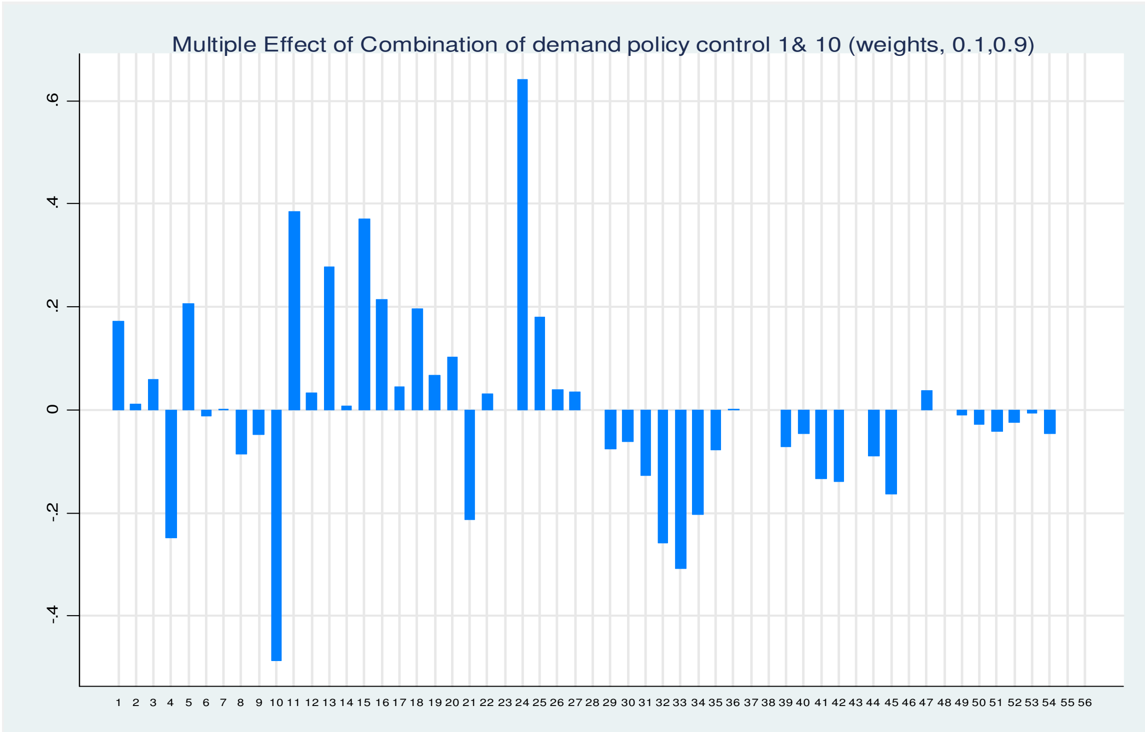
Similarly, figure 1.8 represents the opposite view and is best for environmental policy but not convenient for the economic growth. Individually, both policies $s_{1.}u_1$ and $s_{10.}u_{10}$ are fulfilling one policy at a time. For achieving both goals of economic growth and CO_2 emission reduction, the best policy is combination of policy 1 and 10 because by using the combination of both structures, we can get economic growth as well as CO_2 emission reduction. However, the important point is that by using the combination of $s_{1.}u_1$ and $s_{10.}u_{10}$ structures, there would be achievement of our goals on the basis of trade-off between economic growth (enhancement of output) or CO_2 emission reduction.

Figure 1. 8 Policy control 10



The figure 1.9 stands for the different combinations, so the first graph combination by using the α=1 is best for economic growth but without CO_2 emission reduction. Similarly, the last graph which has been estimated α=0 is convenient for CO_2 emission reduction but without attaining the economic growth. The most convenient graph has been drawing by using α=0.1 and 1-α=0.9 is best for both objectives (economic growth and CO_2 emission reduction).

Figure 1. 9 Convenient Environmnetal Policy



1.8 CONCLUSION

The main findings of current paper have been explored as, first, the impact of oil price shock on the different industrial sectors of China by using the MM approach (base year is 2014). Second, to identify the Key industries in Chinese economy by fulfilling the condition of (FD>1 & BD>1). Third, to identify the convenient structure of policy target (output variable) and policy control (final demand), where oil commodity reduction and output increase are compatible.

The main crux of study explains the results that on average if the (OP) increases 1 US dollar per barrel then the final demand (FD) will be increased to 19,673.6 million dollars in the Chinese economy and vice versa. So, the oil reduction has not any policy suggestion about the oil import reduction, which may be consistent with theory that the oil demand is inelastic with respect to price in the short run.

The results of dispersion analysis show in appendix A-II (table 1.5) that the commodities from 1 to 20 are showing strong forward and backward dispersion (FD>1 & BD>1). However, the results are indicating that industries from 1 to 20 in Chinese economy belong to key industries including both energy-oriented industries like 'Mining and quarrying' and 'Manufacture of coke and refined petroleum products'.

The policy 1 is also most convenient and dominating policy for both industry 4 and industry 10 and supports the economic growth attainment. As, the results portrayed in appendix A-V (table 1.7) suggested that the most relevant component of industry 4 is 1.146, which shows that a demand control tends to have the greatest impact on industry 4 i.e. the *Mining and quarrying*. Similarly, in the case of industry 10 the *Manufacture of coke and refined petroleum products*, the most relevant component is 0.803.

As the structures like s_1u_1 and $s_{10.}u_{10}$ are weak structures and both structures are individually not convenient for whole economic growth and environmental policy (CO_2 emission reduction). The structure s_1u_1 is weak and estimated by using the α=1, which is only best for economic growth but not convenient for CO_2 emission reduction. Similarly, the structure $s_{10.}u_{10}$ is also weak and estimated by using α=0, which is only convenient for CO_2 emission reduction but without attaining the economic growth for Chinese economy.

Usually, policy recommendation for CO_2 emission reduction means there is obviously trade-off between the CO_2 emission reduction and the output of different sectors of the economy. So, due to this limitation, the economist criticized this type of policy recommendation. The current study has tried to fulfil this limitation and recommends the one of the appropriate policies for getting both objectives simultaneously. The combination structure with α=0.1 and 1-α=0.9 is convenient for getting both objectives simultaneously, enhancing the output level (economic growth) and on the other hand reducing the CO_2 emission.

For further development and illustration of broader picture of Chinese economy, the analysis based on SAM will be more useful for analysis because the SAM shows integration of the production with the income flows, including both the generation and the distribution of value added and the creation of final demand.

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Appendix A-I

Table 1. 4 Industries classification for Chinese Input-Output Table

No	*Industries Code*	*Description of Industries*
1	A01	Crop and animal production, hunting and related service activities
2	A02	Forestry and logging
3	A03	Fishing and aquaculture
4	B	Mining and quarrying
5	C10-C12	Manufacture of food products, beverages and tobacco products
6	C13-C15	Manufacture of textiles, wearing apparel and leather products
7	C16	Manufacture of wood and of products of wood and cork, except furniture; etc.
8	C17	Manufacture of paper and paper products
9	C18	Printing and reproduction of recorded media
10	C19	Manufacture of coke and refined petroleum products
11	C20	Manufacture of chemicals and chemical products
12	C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
13	C22	Manufacture of rubber and plastic products
14	C23	Manufacture of other non-metallic mineral products
15	C24	Manufacture of basic metals
16	C25	Manufacture of fabricated metal products, except machinery and equipment
17	C26	Manufacture of computer, electronic and optical products
18	C27	Manufacture of electrical equipment
19	C28	Manufacture of machinery and equipment n.e.c.
20	C29	Manufacture of motor vehicles, trailers and semi-trailers
21	C30	Manufacture of other transport equipment
22	C31_C32	Manufacture of furniture; other manufacturing
23	C33	Repair and installation of machinery and equipment
24	D	Electricity, gas, steam and air conditioning supply
25	E36	Water collection, treatment and supply
26	E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; etc.
27	F	Construction
28	G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
29	G46	Wholesale trade, except of motor vehicles and motorcycles
30	G47	Retail trade, except of motor vehicles and motorcycles
31	H49	Land transport and transport via pipelines
32	H50	Water transport
33	H51	Air transport

34	H52	Warehousing and support activities for transportation
35	H53	Postal and courier activities
36	I	Accommodation and food service activities
37	J58	Publishing activities
38	J59_J60	Motion picture, video and television programme production, sound recording and music publishing activities; etc.
39	J61	Telecommunications
40	J62_J63	Computer programming, consultancy and related activities; information service activities
41	K64	Financial service activities, except insurance and pension funding
42	K65	Insurance, reinsurance and pension funding, except compulsory social security
43	K66	Activities auxiliary to financial services and insurance activities
44	L	Real estate activities
45	M69_M70	Legal and accounting activities; activities of head offices; management consultancy activities
46	M71	Architectural and engineering activities; technical testing and analysis
47	M72	Scientific research and development
48	M73	Advertising and market research
49	M74_M75	Other professional, scientific and technical activities; veterinary activities
50	N	Rental and leasing activities, Employment activities, Travel services, security and services to buildings
51	O	Public administration and defense; compulsory social security
52	P	Education
53	Q	Human health and social work activities
54	R-S	Creative, Arts, Sports, Recreation and entertainment activities and all other personal service activities
55	T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
56	U	Activities of extra-territorial organizations and bodies

Appendix A-II

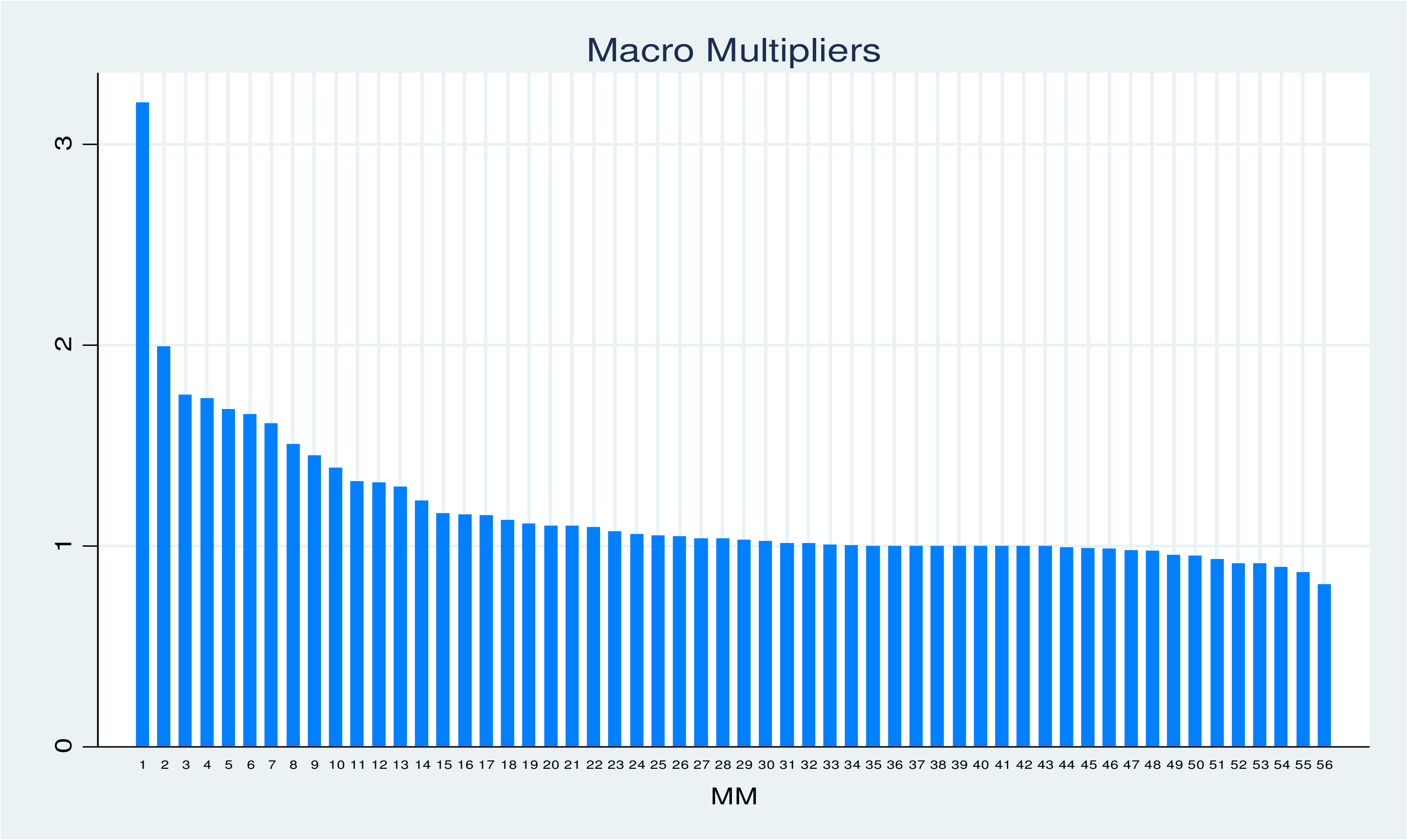
Table 1. 5 Linkages analysis for the Chinese Industries with respect to Forward and Backward Linkages

n.	*Industries*	*Forward Linkages*	*Forward Dispersion*	*Ranks w.r.t Forward Linkages*	*Backward Linkages*	*Backward Dispersion*	*Ranks w.r.t Backward Linkages*	*FD>1 BD>1*
1	Manufacture of chemicals and chemical products	6.45	2.8	1	3.22	1.5	6	X
2	**Mining and quarrying**	6.41	2.8	2	2.31	1.4	33	X
3	Manufacture of basic metals	5.61	2.4	3	3.09	1.4	10	X
4	Electricity, gas, steam and air conditioning supply	5.34	2.3	4	2.98	1.4	13	X
5	Manufacture of food products, beverages and tobacco products	4.94	2.1	5	2.72	1.4	20	X
6	**Manufacture of coke and refined petroleum products**	4.83	2.1	6	2.74	1.4	19	X
7	Crop and animal production, hunting and related service activities	4.53	1.9	7	1.95	1.4	42	X
8	Wholesale trade, except of motor vehicles and motorcycles	4.38	1.9	8	1.87	1.4	44	X
9	Financial service activities, except insurance and pension funding	3.91	1.7	9	1.55	1.3	46	X
10	Manufacture of computer, electronic and optical products	3.87	1.7	10	2.98	1.3	14	X
11	Manufacture of textiles, wearing apparel and leather products	3.40	1.5	11	3.21	1.3	7	X
12	Legal and accounting activities; activities of head offices; management consultancy activities	3.23	1.4	12	2.65	1.3	23	X
13	Manufacture of machinery and equipment n.e.c.	3.20	1.4	13	3.14	1.3	8	X
14	Manufacture of motor vehicles, trailers and semi-trailers	3.17	1.4	14	3.42	1.3	1	X
15	Manufacture of electrical equipment	3.09	1.3	15	3.34	1.3	2	X
16	Manufacture of rubber and plastic products	2.79	1.2	16	3.26	1.3	3	X
17	Land transport and transport via pipelines	2.75	1.2	17	2.23	1.2	37	X
18	Manufacture of wood and of products of wood and cork	2.64	1.1	18	3.08	1.2	11	X
19	Manufacture of paper and paper products	2.62	1.1	19	3.03	1.2	12	X
20	Manufacture of fabricated metal products, except machinery and equipment	2.54	1.1	20	3.24	1.2	4	X
21	Accommodation and food service activities	2.28	1.0	21	2.50	1.2	26	
22	Manufacture of other non-metallic mineral products	2.25	1.0	22	2.92	1.1	16	
23	Other service activities	2.19	0.9	23	2.31	1.1	34	
24	Manufacture of other transport equipment	1.96	0.8	24	3.23	1.1	5	
25	Real estate activities	1.93	0.8	25	1.34	1.1	47	
26	Telecommunications	1.85	0.8	26	1.85	1.1	45	
27	Forestry and logging	1.75	0.8	27	2.37	1.1	30	
28	Retail trade, except of motor vehicles and motorcycles	1.74	0.7	28	1.87	1.0	43	
29	Warehousing and support activities for transportation	1.74	0.7	29	2.46	1.0	27	
30	Manufacture of basic pharmaceutical products and pharmaceutical preparations	1.72	0.7	30	2.75	1.0	18	
31	Other professional, scientific and technical activities; veterinary activities	1.69	0.7	31	2.33	1.0	32	
32	Construction	1.59	0.7	32	3.09	1.0	9	
33	Printing and reproduction of recorded media	1.55	0.7	33	2.95	1.0	15	
34	Water transport	1.45	0.6	34	2.43	1.0	28	
35	Insurance, reinsurance and pension funding, except compulsory social security	1.42	0.6	35	2.27	1.0	36	

36	Fishing and aquaculture	1.37	0.6	36	2.00	1.0	40
37	Air transport	1.29	0.6	37	2.77	1.0	17
38	Sewerage; waste collection, treatment and disposal activities	1.28	0.6	38	2.62	0.9	25
39	Scientific research and development	1.26	0.5	39	2.43	0.9	29
40	Manufacture of furniture; other manufacturing	1.25	0.5	40	2.64	0.9	24
41	Education	1.22	0.5	41	1.98	0.9	41
42	Public administration and defence; compulsory social security	1.18	0.5	42	2.06	0.8	39
43	Computer programming, consultancy and related activities; information service activities	1.16	0.5	43	2.36	0.8	31
44	Water collection, treatment and supply	1.15	0.5	44	2.68	0.8	22
45	Postal and courier activities	1.13	0.5	45	2.10	0.8	38
46	Administrative and support service activities	1.11	0.5	46	2.29	0.7	35
47	Human health and social work activities	1.08	0.5	47	2.68	0.6	21
48	Wholesale and retail trade and repair of motor vehicles and motorcycles	1.00	0.4	48	1.00	0.4	48
49	Repair and installation of machinery and equipment	1.00	0.4	49	1.00	0.4	49
50	Publishing activities	1.00	0.4	50	1.00	0.4	50
51	Motion picture, video and television programme production	1.00	0.4	51	1.00	0.4	51
52	Architectural and engineering activities; technical testing and analysis	1.00	0.4	52	1.00	0.4	52
53	Advertising and market research	1.00	0.4	53	1.00	0.4	53
54	Activities of households as employers	1.00	0.4	54	1.00	0.4	54
55	Activities of extraterritorial organizations and bodies	1.00	0.4	55	1.00	0.4	55
56	Activities auxiliary to financial services and insurance activities	1.00	0.4	56	1.00	0.4	56

Appendix A-III

Figure 1. 10 Macro Multipliers with respect to Industries



Appendix A-IV

Table 1. 6 Macro Multipliers based on R Matrix

Industries	*S*		*Industries*	*S*	
1	s1	3.208	29	s29	1.029
2	s2	1.993	30	s30	1.024
3	s3	1.754	31	s31	1.014
4	s4	1.734	32	s32	1.013
5	s5	1.679	33	s33	1.006
6	s6	1.655	34	s34	1.002
7	s7	1.611	35	s35	1.000
8	s8	1.506	36	s36	1.000
9	s9	1.450	37	s37	1.000
10	s10	1.387	38	s38	1.000
11	s11	1.322	39	s39	1.000
12	s12	1.316	40	s40	1.000
13	s13	1.293	41	s41	1.000
14	s14	1.227	42	s42	1.000
15	s15	1.164	43	s43	1.000
16	s16	1.155	44	s44	0.993
17	s17	1.153	45	s45	0.989
18	s18	1.126	46	s46	0.984
19	s19	1.109	47	s47	0.978
20	s20	1.102	48	s48	0.974
21	s21	1.102	49	s49	0.954
22	s22	1.094	50	s50	0.950
23	s23	1.071	51	s51	0.934
24	s24	1.059	52	s52	0.914
25	s25	1.053	53	s53	0.914
26	s26	1.048	54	s54	0.894
27	s27	1.038	55	s55	0.866
28	s28	1.036	56	s56	0.807

Appendix A-V

Table 1. 7 Effect on total output of policy 1,10 and combination of policy 1 & 10

Industries	$s_1.u_1$	$s_{10}.u_{10}$	$\alpha0.1* s_1.u_1+(1-\alpha0.1) * s_{10}.u_{10}$	*Industries*	$s_1.u_1$	$s_{10}.u_{10}$	$\alpha0.1* s_1.u_1+(1-\alpha0.1) * s_{10}.u_{10}$
1	0.594	0.125	0.172	29	0.579	-0.149	-0.076
2	0.212	-0.012	0.011	30	0.156	-0.086	-0.062
3	0.113	0.054	0.060	31	0.362	-0.183	-0.128
4	1.146	-0.403	-0.248	32	0.161	-0.304	-0.258
5	0.679	0.153	0.205	33	0.157	-0.360	-0.308
6	0.567	-0.078	-0.013	34	0.205	-0.249	-0.204
7	0.391	-0.041	0.002	35	0.076	-0.096	-0.078
8	0.384	-0.138	-0.086	36	0.264	-0.030	0.000
9	0.195	-0.076	-0.049	37	0.000	0.000	0.000
10	0.803	-0.630	-0.487	38	0.000	0.000	0.000
11	1.180	0.296	0.385	39	0.142	-0.095	-0.071
12	0.197	0.014	0.033	40	0.093	-0.062	-0.046
13	0.504	0.252	0.277	41	0.457	-0.200	-0.134
14	0.358	-0.032	0.007	42	0.111	-0.167	-0.139
15	1.080	0.292	0.370	43	0.000	0.000	0.000
16	0.452	0.189	0.215	44	0.133	-0.113	-0.089
17	0.597	-0.017	0.045	45	0.418	-0.229	-0.164
18	0.530	0.160	0.197	46	0.000	0.000	0.000
19	0.549	0.013	0.067	47	0.133	0.028	0.038
20	0.529	0.056	0.103	48	0.000	0.000	0.000
21	0.287	-0.268	-0.212	49	0.190	-0.033	-0.011
22	0.153	0.019	0.032	50	0.099	-0.043	-0.029
23	0.000	0.000	0.000	51	0.083	-0.057	-0.043
24	0.976	0.603	0.640	52	0.081	-0.036	-0.025
25	0.139	0.184	0.179	53	0.103	-0.019	-0.007
26	0.142	0.028	0.039	54	0.247	-0.078	-0.045
27	0.227	0.014	0.035	55	0.000	0.000	0.000
28	0.000	0.000	0.000	56	0.000	0.000	0.000

Appendix A-VI

Figure 1. 11 Convenient policies for Economic Growth and Environmental Policy (CO_2 emission reduction)

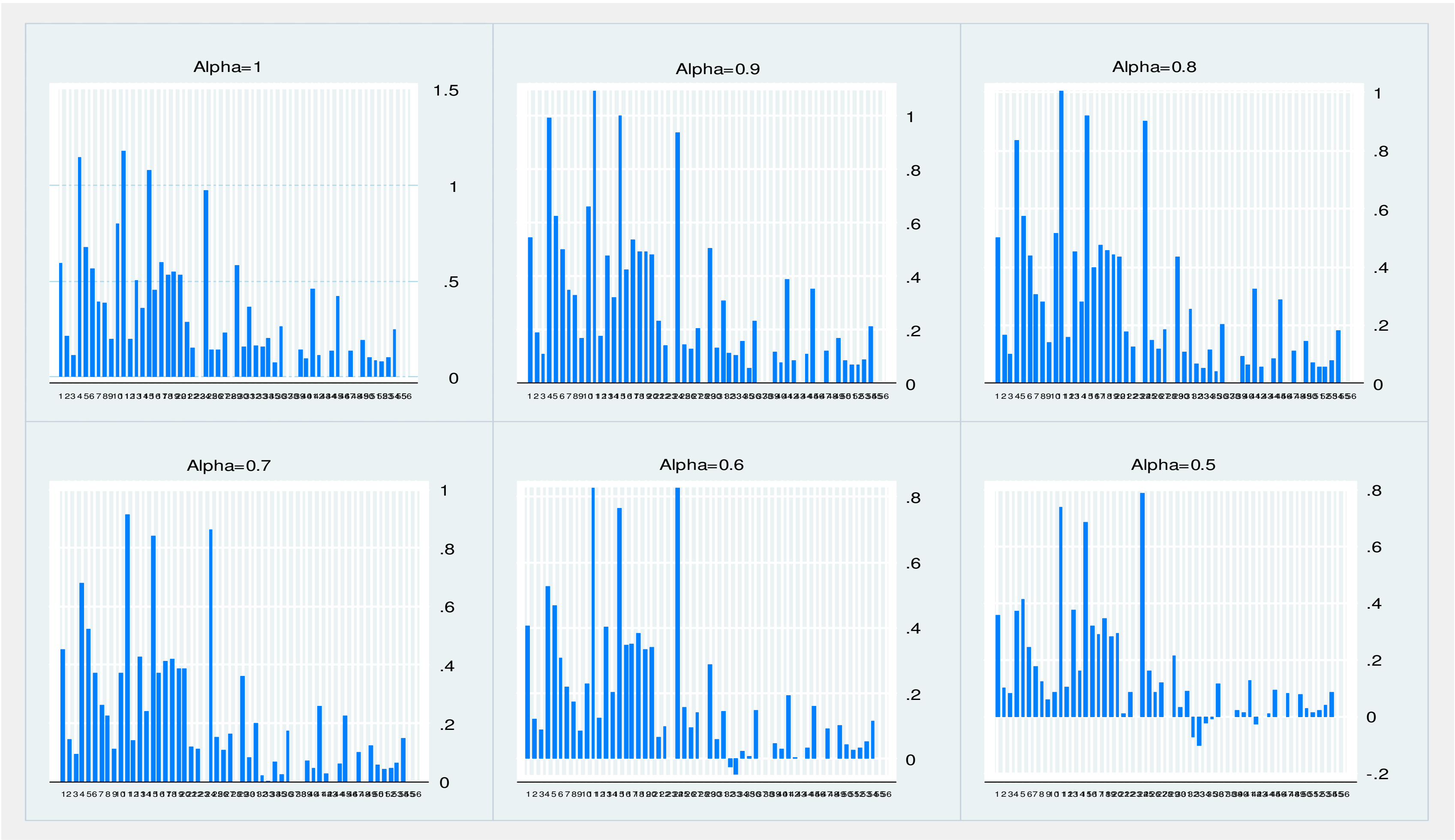
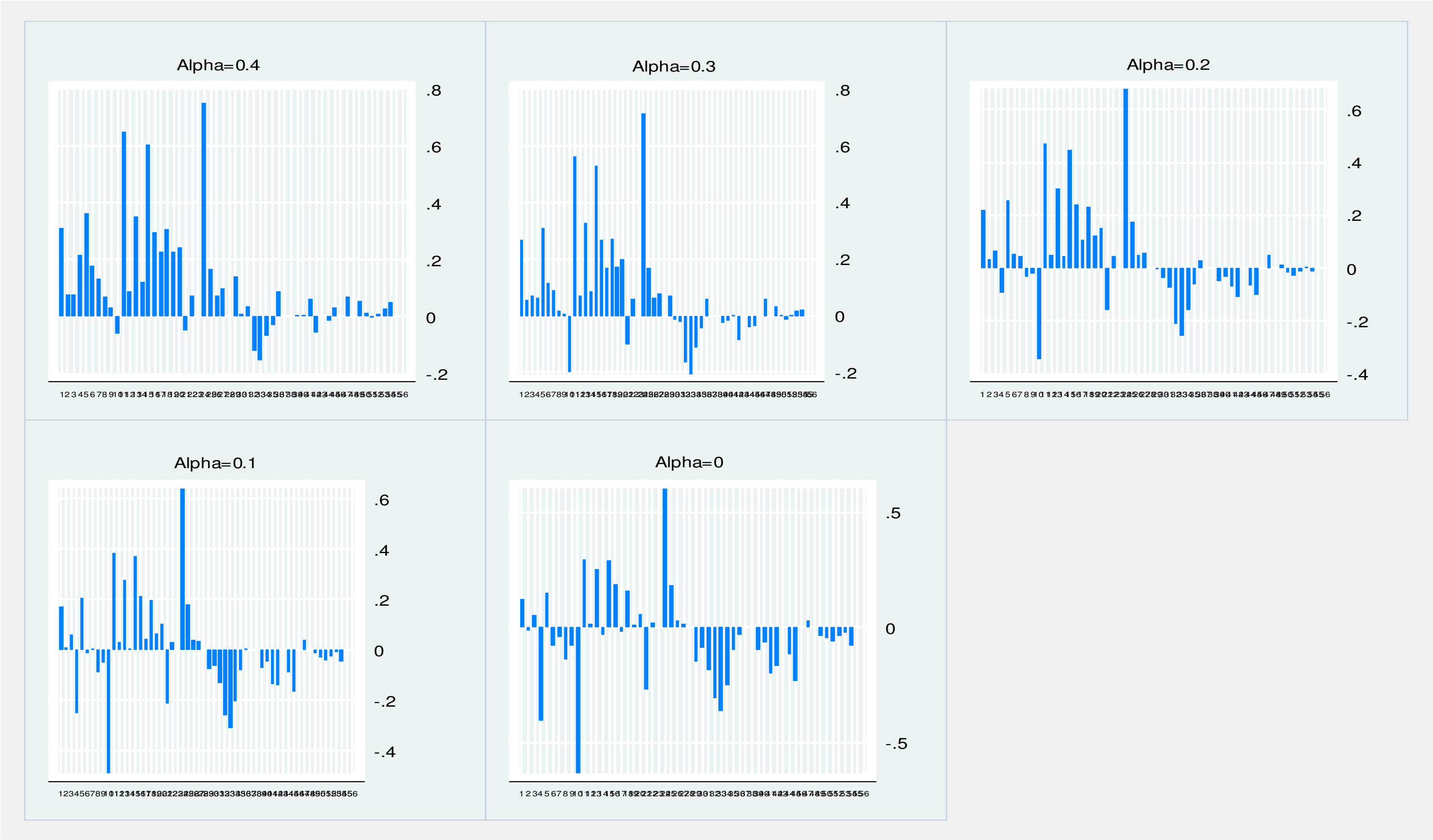


Figure 1.11 (Continue)



Appendix A-VII

Table 1. 8 Direct and Indirect effects of a unitary demand shock on total output by Industries

	f1	f2	f3	f4	f5	f6	f7	f8	f9	f10	f11	f12	f13	f14	f15	f16	f17	f18	f19
x1	1.21	0.15	0.17	0.02	0.50	0.25	0.08	0.13	0.06	0.02	0.06	0.29	0.05	0.03	0.02	0.03	0.02	0.03	0.03
x2	0.00	1.17	0.00	0.01	0.00	0.01	0.21	0.06	0.03	0.00	0.01	0.01	0.04	0.01	0.01	0.01	0.01	0.01	0.01
x3	0.01	0.00	1.05	0.00	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x4	0.04	0.09	0.03	1.20	0.04	0.07	0.08	0.11	0.09	0.64	0.25	0.07	0.15	0.25	0.37	0.20	0.08	0.16	0.13
x5	0.19	0.05	0.31	0.03	1.42	0.12	0.05	0.07	0.06	0.04	0.11	0.14	0.07	0.05	0.04	0.05	0.04	0.05	0.05
x6	0.01	0.02	0.01	0.02	0.02	1.80	0.03	0.04	0.04	0.02	0.04	0.05	0.12	0.04	0.03	0.04	0.02	0.04	0.04
x7	0.00	0.01	0.00	0.03	0.01	0.01	1.67	0.07	0.05	0.02	0.02	0.01	0.02	0.03	0.02	0.04	0.01	0.02	0.03
x8	0.01	0.01	0.01	0.01	0.02	0.02	0.02	1.38	0.46	0.01	0.02	0.03	0.02	0.03	0.01	0.02	0.02	0.02	0.02
x9	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	1.04	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
x10	0.05	0.10	0.04	0.08	0.04	0.06	0.07	0.08	0.07	1.15	0.23	0.07	0.13	0.12	0.14	0.10	0.05	0.09	0.07
x11	0.12	0.17	0.04	0.08	0.08	0.19	0.18	0.25	0.22	0.10	1.53	0.14	0.56	0.16	0.09	0.13	0.11	0.17	0.11
x12	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	1.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x13	0.02	0.02	0.01	0.02	0.03	0.05	0.03	0.05	0.09	0.02	0.07	0.03	1.26	0.04	0.02	0.04	0.07	0.09	0.06
x14	0.00	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	1.22	0.04	0.04	0.03	0.06	0.03
x15	0.02	0.04	0.02	0.10	0.02	0.03	0.05	0.05	0.06	0.08	0.07	0.03	0.07	0.11	1.48	0.50	0.13	0.41	0.32
x16	0.01	0.02	0.01	0.04	0.01	0.01	0.05	0.03	0.03	0.03	0.03	0.02	0.04	0.06	0.05	1.17	0.04	0.08	0.09
x17	0.01	0.02	0.01	0.04	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.04	0.04	1.64	0.14	0.13
x18	0.01	0.02	0.01	0.03	0.01	0.02	0.02	0.03	0.02	0.03	0.03	0.02	0.03	0.03	0.04	0.05	0.11	1.23	0.11
x19	0.02	0.05	0.02	0.08	0.02	0.03	0.04	0.04	0.04	0.06	0.05	0.03	0.04	0.07	0.08	0.10	0.05	0.10	1.25
x20	0.01	0.03	0.01	0.03	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.03	0.04	0.02	0.03	0.08
x21	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
x22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.00	0.01	0.01
x23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x24	0.04	0.06	0.03	0.14	0.05	0.08	0.09	0.13	0.09	0.12	0.19	0.08	0.13	0.18	0.18	0.18	0.07	0.12	0.11
x25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x27	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
x28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 1.8 (Continue)

	f1	**f2**	**f3**	**f4**	**f5**	**f6**	**f7**	**f8**	**f9**	**f10**	**f11**	**f12**	**f13**	**f14**	**f15**	**f16**	**f17**	**f18**	**f19**
x29	0.04	0.06	0.05	0.05	0.10	0.13	0.07	0.08	0.09	0.05	0.08	0.09	0.11	0.07	0.05	0.08	0.11	0.10	0.09
x30	0.01	0.01	0.01	0.01	0.02	0.03	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02
x31	0.02	0.04	0.02	0.03	0.04	0.04	0.05	0.05	0.05	0.04	0.05	0.04	0.05	0.06	0.05	0.05	0.03	0.05	0.05
x32	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
x33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00
x34	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.02	0.01	0.02	0.02	0.01	0.02	0.01	0.02	0.02
x35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x36	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.03
x37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x39	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
x40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
x41	0.02	0.04	0.03	0.06	0.04	0.04	0.05	0.06	0.06	0.05	0.06	0.05	0.06	0.06	0.08	0.07	0.06	0.07	0.06
x42	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01
x43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x44	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
x45	0.01	0.02	0.02	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.09	0.05	0.04	0.04	0.05	0.05	0.05	0.05
x46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x47	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.02	0.01	0.01
x48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x49	0.01	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.02	0.02	0.02
x50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x54	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
x55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	**1.95**	**2.37**	**2.00**	**2.31**	**2.72**	**3.21**	**3.08**	**3.03**	**2.95**	**2.74**	**3.22**	**2.75**	**3.26**	**2.92**	**3.09**	**3.24**	**2.98**	**3.34**	**3.14**

Table 1.8 (Continue)

	f20	f21	f22	f23	f24	f25	f26	f27	f28	f29	f30	f31	f32	f33	f34	f35	f36	f37	f38
x1	0.03	0.03	0.06	0.00	0.02	0.03	0.05	0.03	0.00	0.02	0.02	0.02	0.03	0.04	0.11	0.02	0.24	0	0
x2	0.01	0.01	0.04	0.00	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
x3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.07	0	0
x4	0.11	0.12	0.09	0.00	0.35	0.12	0.09	0.16	0.00	0.03	0.03	0.11	0.14	0.19	0.12	0.05	0.03	0	0
x5	0.04	0.04	0.05	0.00	0.04	0.06	0.07	0.04	0.00	0.03	0.03	0.04	0.06	0.09	0.07	0.04	0.50	0	0
x6	0.07	0.04	0.15	0.00	0.02	0.03	0.05	0.04	0.00	0.01	0.01	0.02	0.01	0.03	0.03	0.02	0.03	0	0
x7	0.02	0.02	0.23	0.00	0.01	0.01	0.03	0.08	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0	0
x8	0.01	0.01	0.04	0.00	0.01	0.01	0.01	0.02	0.00	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0	0
x9	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.02	0.02	0.00	0.00	0.01	0.01	0.02	0.01	0	0
x10	0.07	0.07	0.06	0.00	0.11	0.06	0.08	0.09	0.00	0.03	0.03	0.15	0.21	0.29	0.17	0.05	0.03	0	0
x11	0.10	0.11	0.14	0.00	0.06	0.12	0.11	0.13	0.00	0.03	0.03	0.05	0.05	0.07	0.08	0.04	0.06	0	0
x12	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
x13	0.08	0.08	0.06	0.00	0.02	0.05	0.03	0.04	0.00	0.01	0.01	0.03	0.02	0.02	0.02	0.02	0.02	0	0
x14	0.03	0.03	0.02	0.00	0.02	0.02	0.03	0.24	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0	0
x15	0.25	0.28	0.13	0.00	0.08	0.06	0.06	0.27	0.00	0.02	0.02	0.05	0.06	0.08	0.05	0.05	0.02	0	0
x16	0.05	0.07	0.04	0.00	0.02	0.04	0.03	0.08	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.02	0.01	0	0
x17	0.07	0.14	0.03	0.00	0.08	0.04	0.06	0.04	0.00	0.03	0.03	0.02	0.03	0.04	0.03	0.03	0.01	0	0
x18	0.06	0.16	0.03	0.00	0.10	0.04	0.05	0.08	0.00	0.03	0.03	0.02	0.03	0.04	0.02	0.03	0.01	0	0
x19	0.10	0.15	0.04	0.00	0.05	0.04	0.04	0.06	0.00	0.01	0.01	0.03	0.05	0.09	0.06	0.03	0.01	0	0
x20	1.70	0.04	0.02	0.00	0.02	0.02	0.07	0.03	0.00	0.02	0.02	0.14	0.02	0.02	0.03	0.05	0.01	0	0
x21	0.01	1.30	0.00	0.00	0.00	0.01	0.02	0.01	0.00	0.00	0.00	0.02	0.10	0.15	0.01	0.11	0.00	0	0
x22	0.01	0.01	1.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
x23	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
x24	0.09	0.09	0.07	0.00	1.56	0.32	0.10	0.12	0.00	0.04	0.04	0.07	0.04	0.06	0.06	0.04	0.04	0	0
x25	0.00	0.00	0.00	0.00	0.00	1.06	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
x26	0.00	0.00	0.00	0.00	0.01	0.11	1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0
x27	0.01	0.01	0.01	0.00	0.02	0.02	0.04	1.05	0.00	0.01	0.01	0.02	0.01	0.01	0.02	0.02	0.01	0	0
x28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0

Table 1.8 (Continue)

	f20	f21	f22	f23	f24	f25	f26	f27	f28	f29	f30	f31	f32	f33	f34	f35	f36	f37	f38
x29	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.0	1.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0
x30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	1.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
x32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0
x33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0
x34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	1.0	0.0	0.0	0.0	0.0
x35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
x36	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
x37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
x38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
x39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x41	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
x42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x45	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x54	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
x55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
x56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sum	**3.4**	**3.2**	**2.6**	**1.0**	**3.0**	**2.7**	**2.6**	**3.1**	**1.0**	**1.9**	**1.9**	**2.2**	**2.4**	**2.8**	**2.5**	**2.1**	**2.5**	**1.0**	**1.0**

Table 1.8 (Continue)

	f39	f40	f41	f42	f43	f44	f45	f46	f47	f48	f49	f50	f51	f52	f53	f54	f55	f56	x	f
x1	0.02	0.02	0.01	0.05	0.00	0.01	0.05	0.00	0.07	0.00	0.03	0.09	0.04	0.05	0.13	0.05	0.00	0.00	**4.53**	**1**
x2	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.75**	**1**
x3	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.03	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	**1.37**	**1**
x4	0.03	0.04	0.02	0.02	0.00	0.01	0.08	0.00	0.06	0.00	0.07	0.07	0.04	0.04	0.06	0.05	0.00	0.00	**6.41**	**1**
x5	0.03	0.03	0.02	0.10	0.00	0.01	0.08	0.00	0.09	0.00	0.05	0.05	0.07	0.09	0.10	0.10	0.00	0.00	**4.94**	**1**
x6	0.01	0.02	0.01	0.02	0.00	0.01	0.05	0.00	0.04	0.00	0.02	0.03	0.07	0.02	0.09	0.05	0.00	0.00	**3.40**	**1**
x7	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	**2.64**	**1**
x8	0.01	0.04	0.01	0.02	0.00	0.00	0.07	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.02	0.03	0.00	0.00	**2.62**	**1**
x9	0.01	0.06	0.02	0.02	0.00	0.00	0.04	0.00	0.01	0.00	0.01	0.02	0.02	0.01	0.01	0.02	0.00	0.00	**1.55**	**1**
x10	0.02	0.03	0.02	0.02	0.00	0.01	0.10	0.00	0.05	0.00	0.07	0.08	0.05	0.04	0.06	0.04	0.00	0.00	**4.83**	**1**
x11	0.03	0.06	0.02	0.03	0.00	0.01	0.09	0.00	0.13	0.00	0.09	0.09	0.05	0.06	0.08	0.10	0.00	0.00	**6.45**	**1**
x12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.00	**1.72**	**1**
x13	0.01	0.02	0.01	0.01	0.00	0.00	0.03	0.00	0.02	0.00	0.02	0.03	0.01	0.01	0.02	0.03	0.00	0.00	**2.79**	**1**
x14	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.02	0.00	0.01	0.02	0.01	0.01	0.02	0.01	0.00	0.00	**2.25**	**1**
x15	0.04	0.04	0.01	0.02	0.00	0.01	0.07	0.00	0.07	0.00	0.06	0.05	0.03	0.02	0.04	0.05	0.00	0.00	**5.61**	**1**
x16	0.01	0.02	0.01	0.01	0.00	0.01	0.04	0.00	0.04	0.00	0.05	0.02	0.01	0.01	0.02	0.02	0.00	0.00	**2.54**	**1**
x17	0.08	0.21	0.01	0.02	0.00	0.01	0.08	0.00	0.10	0.00	0.15	0.04	0.02	0.04	0.03	0.07	0.00	0.00	**3.87**	**1**
x18	0.09	0.05	0.01	0.02	0.00	0.01	0.07	0.00	0.09	0.00	0.05	0.03	0.02	0.02	0.03	0.04	0.00	0.00	**3.09**	**1**
x19	0.02	0.02	0.01	0.01	0.00	0.00	0.03	0.00	0.03	0.00	0.03	0.02	0.01	0.01	0.06	0.02	0.00	0.00	**3.20**	**1**
x20	0.01	0.04	0.01	0.02	0.00	0.01	0.11	0.00	0.03	0.00	0.04	0.06	0.04	0.01	0.02	0.05	0.00	0.00	**3.17**	**1**
x21	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.04	0.00	0.00	**1.96**	**1**
x22	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	**1.25**	**1**
x23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.00**	**1**
x24	0.04	0.03	0.02	0.02	0.00	0.01	0.05	0.00	0.06	0.00	0.04	0.07	0.04	0.04	0.06	0.06	0.00	0.00	**5.34**	**1**
x25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.15**	**1**
x26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.28**	**1**
x27	0.01	0.01	0.01	0.01	0.00	0.03	0.01	0.00	0.02	0.00	0.01	0.03	0.02	0.02	0.01	0.02	0.00	0.00	**1.59**	**1**
x28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.00**	**1**

Table 1.8 (Continue)

	f39	**f40**	**f41**	**f42**	**f43**	**f44**	**f45**	**f46**	**f47**	**f48**	**f49**	**f50**	**f51**	**f52**	**f53**	**f54**	**f55**	**f56**	**x**	**f**
x29	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.0	**4.38**	**1**
x30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.74**	**1**
x31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**2.75**	**1**
x32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.45**	**1**
x33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.29**	**1**
x34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.74**	**1**
x35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.13**	**1**
x36	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	**2.28**	**1**
x37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.00**	**1**
x38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.00**	**1**
x39	1.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.85**	**1**
x40	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.16**	**1**
x41	0.0	0.1	1.0	0.2	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	**3.91**	**1**
x42	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.42**	**1**
x43	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.00**	**1**
x44	0.0	0.0	0.1	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	**1.93**	**1**
x45	0.0	0.1	0.1	0.1	0.0	0.0	1.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**3.23**	**1**
x46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.00**	**1**
x47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.26**	**1**
x48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.00**	**1**
x49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.69**	**1**
x50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.11**	**1**
x51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	**1.18**	**1**
x52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	**1.22**	**1**
x53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	**1.08**	**1**
x54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	1.1	0.0	0.0	**2.19**	**1**
x55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	**1.00**	**1**
x56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	**1.00**	**1**
Sum	**1.8**	**2.4**	**1.5**	**2.3**	**1.0**	**1.3**	**2.6**	**1.0**	**2.4**	**1.0**	**2.3**	**2.3**	**2.1**	**2.0**	**2.7**	**2.3**	**1.0**	**1.0**	**130.27**	**56**

2 Convenient Structure for Oil and Gas Sectors for Russian Economy: SAM based Macro Multiplier Approach

Abstract

The economy of Russia is significantly dependent upon the energy related products like oil and gas. The export share of oil and gas in Russian economy is approximately 58%. Nowadays, oil producing countries are facing the problem of maintaining the balance of payment because low oil price is adversely affecting their export earnings. The fiscal deficit in Russian economy has been increased significantly. The comparison of first nine months of 2016 and 2015 depicts the figures with 2.6% and 1.1% respectively. Overall, the Russian economy contracted 3.4% due to fall in the prices of oil. There are two main objectives of current study; First, to identify the convenient structure of the economy for analysing the trade-off between the oil and gas sector with 'Dutch disease' by using Macro multiplier approach (MM). Second, to identify the key industries for Russian economy by using linkage MM based linkage analysis. The significance of the study is to use the SAM based Macro multiplier (MM) approach for year 2015 to fulfil the required objectives, which is only unique and first study on Russia. The present study contributes to the literature in achieving the objectives in two ways. First to analyse the linkage analysis (based on Macro Multiplier approach) for Russian 59 by 59 commodities by using Symmetric SAM; Second to identify the convenient structure for energy dominating commodities for Russia. The empirical analysis is based on the MM approach proposed by Ciaschini & Socci (2006). The advantage of MM approach is to find out the appropriate set of 'endogenous' policy profiles. Moreover, MM approach is to interlink the different economic interaction with macroeconomic variables, which are even active or non-active, (Ciaschini et al., 2010).

JEL Classification: O13, P28, P48, Q43

Key Words: Oil, Gas, Russia, Social Accounting Matrix, Macro Multiplier Analysis

2.1 INTRODUCTION

Russian economy is mostly based on the export of energy related products (oil and gas) and weapons. In addition, 70% of Russian GDP and 50% of federal revenue depends upon the exports of energy products. The two-third of Russian economy is based on the export of energy related products (oil and gas) and due to lower oil prices the 2 $trillion Russian economy can fall into recession. Russia is an important country with respect to supplier of energy products (oil and gas). The export of crude oil is around $89.6 billion that approximates around 27% of total exports of Russia. Gazprom and Surgutneftegaz are the two-major oil and gas companies working since 1989 and 1994 respectively in Russia. At present, the price of crude oil in International market is around $53 per barrel, varying between $40 to $50 per barrel in the fourth quarter of 2016. The Russian officials announced their budget of 2016 by assuming that the average price of oil during the 2015-16 will be around $50, which was an overestimate because price was fluctuating around $35 dollar per barrel due to a sudden fall between June and December 2014.

Nowadays the Russian economy is facing some serious challenges; first, Russia is facing economic sanctions from US and EU due to Ukrainian crises. Second, due to reduction in oil prices, Russian economy is facing difficulty to maintain the balanced budget. Third, due to more contribution of Chinese arms export, Russian economy is facing furious competition in arms market. The most crucial challenge facing by Russian economy is due to fall in oil prices. If there appears any shock in terms of energy related imports both in the form of quantity and price, there will be a chance of significant impact on the Russian economy.

A severe oil price shock has been witnessed in the previous three years due to many reasons. First, due to restoration of oil production in Libya and Iraq (Arezki & Blanchard, 2014). Second, due increase in the production of unconventional oil like Shale oil consisting of 5% global oil production. Third, due to weakening global demand, the prices suddenly fell around 44% or $49 per barrel. This sudden fluctuation in the price of oil affected many economies of the world and made it expensive to make balanced budget. Due to low prices of oil, the economies of oil exporter countries like (OPEC and Russia) have been damaged and on the other hand, the major oil importer countries like China and India, etc received the positive impact on their economy. Overall the low price is good news for countries except of oil exporting countries, the impact of low energy prices as an offset the taxes in oil consuming countries (Papatulica & Prisecaru, 2016). Fourth, due to oil price there has been 8% appreciation in US dollar since June 2014. The trade of crude oil is linked with US dollar, so it makes expensive for those oil refineries to purchase the oil, which are located outside the US and it is further reducing the demand of non-U.S oil, (Baumeister & Kilian, 2016).

The low oil prices adversely affect the investment of oil companies in oil sectors and approximately $400 billion worth of projects have been delayed[9]. Wood MacKenzie is a famous consulting firm and estimated that 68 oil and gas projects have been affected and delayed[10]. So, the total worth of 68 affected oil and gas projects worth of $380 billion have been delayed[11]. The initial impact of oil price fall on Russian currency rouble has been observed in the form of 40% depreciation in 2014[12].

The phenomenon, where dominating (exporting) sectors based on natural resource extraction will exploit the agriculture or manufacturing sectors is referred as Dutch disease (DD).[13] This concept became a part of literature for the first time in 1959 when Netherlands explored natural oil and gas from North Sea. In the scenario of DD[14], the GDP of natural resource enriched countries is depending upon the resource enriched sectors (export of oil and gas, etc) of the economy. These resource enriched sectors are usually export dominating sectors of the economy, so the marginal productivity of these sectors rises, and the pay factors employed more than other sectors. Therefore, in the result factors resources are pulled out in these booming sectors at the expense of other non-tradable sectors (agriculture, manufacturing, etc.).At the result of this imbalance allocation of resources the economy is trapped in de-industrialization (Alley et al., 2014).There is substantial level of studies like (Bruno & Sachs, 1982); (Corden & Neary, 1982); (Eastwood & Venables, 1982); (Corden, 1984); (Van Wijnbergen, 1984) and (Neary & van Wijnbergen,1984) among many more.

There are two main objectives of current study; First, to identify the convenient structure of the economy for analysing the trade-off between the oil and gas sector with

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[9]https://www.ft.com/content/50bbaec2-ba0e-11e5-bf7e-8a339b6f2164#axzz408EMdxEi

[10] https://www.woodmac.com/media-centre/12530462

[11]https://www.wsj.com/articles/oil-rout-forces-companies-to-delay-decisions-on-380-billion-in-projects-1452775590

[12]http://arabenergyclub.com/site/wp-content/uploads/2015/02/Seven-Questions-about-the-Recent-Oil-Price-1.pdf

[13] There are usually four symptoms of "Dutch disease", (1) Appreciation of real exchange rate, (2) Slowdown of manufacturing growth, (3) Grooming of servicing sector (Domination of "spending effect" on "Resource movement effect" and (4) increase in overall wage rate.

[14] Firstly, DD term used in "The Dutch Disease" (November 26, 1977). *The Economist*, pp. 82–83.

‘Dutch disease’ by using Macro multiplier approach (MM). Second, to identify the key industries for Russian economy by using linkage MM based linkage analysis. The empirical analysis is based on the SAM based MM approach, which is based on the study of (Chiaschini et al., 2007b) developed SAM for Italy and current study is applying latest developed Financial Social Accounting Matrix of Russia for year 2015. The significance of current study is to identify the key industries in Russian economy by using linkage analysis and also identify the convenient structure for energy dominated commodities.

There are many advantages of MM approach. The first advantage of MM approach is to find out the appropriate set of ‘endogenous’ policy profiles. The second advantage of MM approach is to interlink the different economic interaction with macro-economic variables, which are even active or non-active, (Ciaschini et al., 2010). The third advantage of MM approach is to depict the comprehensive picture of economy by using the macro variables, which is missed by the traditional approaches (impact analysis, etc.). The fourth advantage of MM approach is a powerful tool to identify the most proper structure of exogenous variable (final demand) and further its impact on total output due to any shock in the economy (Ciaschini & Socci, 2006). The fifth advantage of MM approach is to overcome the traditional limitation of unrealistic structure of exogenous shock by using the traditional multiplier analysis (Ciaschini et al. 2009). The more detail explanation of MM method is explained in the methodology section.

The Subsection 2.1.1 provides a detailed overview of Russian oil and gas sector. Section 2.3 explains the Financial Social Accounting Matrix. Subsection 2.3.1 explains the Advantages of Social Accounting Matrix. Subsection 2.3.2 explains the Disadvantages of Social Accounting Matrix. Subsection 2.3.3 represents the Framework of Russian Social Accounting Matrix. Subsection 2.3.4 represents the Blocks of Social Accounting Matrix. Subsection 2.3.5 represents the Balancing procedure of Social Accounting Matrix. Section 2.4 represents the Methodology. Section 2.5 represents the Empirical analysis of Dispersion approach. Section 2.6 represents the Empirical analysis of MM approach and last section concludes the paper.

2.2 LITERATURE REVIEW

2.2.1 Overview of Russian Oil Sector

Global oil consumption grew 1.9% in 2016, which surpassed the previous +1% in 2014. On the other hand, Global oil production has been increased more rapidly than the consumption in last two consecutive years, rising with 3.2%, the strongest growth since 2004[15]. The total oil proven reserves for Russia at the end of 2015 are 14 (thousand million tonnes)[16]. Similarly, the oil production for Russia is 10,980 (thousands of barrels per day)[17]. The Russian budget for year 2016 is based on supposition of oil price of $50 per barrel and also expecting the 3% deficit of GDP, which is approximately $27 billion at the current exchange rate RR80=US$1[18]. If we compare the total expenditures and revenues in Russia for first nine months of 2015 and 2016, we can observe that the expenditures are 18.6% and 17.9% of GDP, and revenues are 17.5% and 13.9% of GDP, respectively. Similarly, the revenue from oil and gas has been decreased from 7.8% to 5.6% of GDP respectively[19].

In the context of Russia, positive correlation has been observed between the oil price and Russian GDP growth (Semko, 2013). Similarly, the past study like (Rautava, 2004) reported that if there is 10% permanent increase (decrease) in oil price then its leads 2.2% increase (decrease) in Russia GDP. On the other hand, 10% increase (decrease) in oil price leads 3% increase (decrease) in Russian Government real revenue. Some studies investigated the short-run relationship between the fluctuations in oil prices and real exchange rates (Narayan et al., 2008; Ghosh, 2011; Mansor, 2011 and Selmi et al., 2012).

Tuzova & Qayum (2016) analysed some crucial aftermath due to Ukrainian crises. First, massive capital outflow has been noted and it further affects the (capital and financial accounts) of Russia. Similarly, the value of rouble has been deteriorated and it increased the cost of borrowing. Second, Russian banks also faced the financial issues that resulted in restrictions from the international financial institutions. Third, due to this uncertainty, the confidence of consumer and producer has been deteriorated. Fourth, massive decreasing

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[15] BP Statistical Review of World Energy (2016), 3.

[16] Ibid,. 6.

[17] Ibid,. 8.

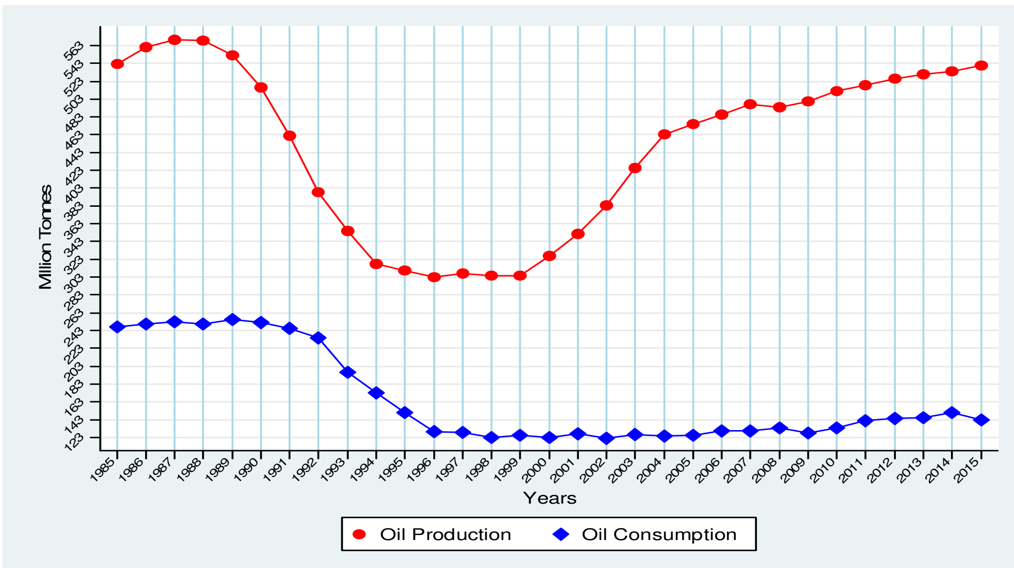
[18] https://www.oxfordenergy.org/wpcms/wp-content/uploads/2016/02/Russia-and-OPEC-Uneasy-Partners.pdf, 4.

[19] http://documents.worldbank.org/curated/en/424231478762595715/pdf/110037-WP-P161778-PUBLIC-ENGLISH NovfinalRussiaInchingtowardsGrowthRERfinal.pdf, 8.

trend of foreign direct investment in Russia has been observed and FDI decreased approximately 47% in the first three quarters, [See, World Bank Report, 2015].

The figure 2.1 below shows that both production and consumption has been increasing from year 1985 to 2015. The graph indicated that a big shock has been observed between 1992 to 2004 in oil production and consumption, which may be due to collapse of USSR (also indicating the structural change in the economy of Russia). There are more fluctuations in the production of oil, the decreasing trend has been started from 1992 to 2004, after year 2004 the oil production was increasing rapidly.

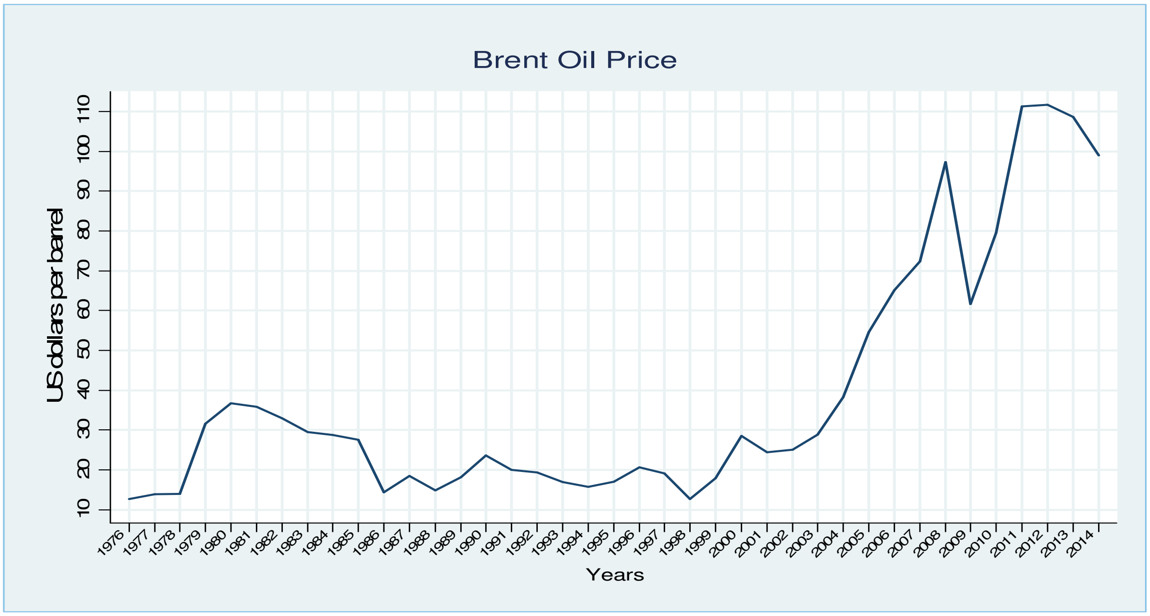
Figure 2. 1 Oil Production and Consumption of Russia, Million Tonnes



Note: Data for Oil production and consumption taken from BP Statistical Review of World Energy (2016)

The figure 2.2 depicts the lot of fluctuations for Brent oil in International market from year 1976 to 2014, especially severe up and downs have been observed between the year 2008 to 2012. The figure 2.2 clearly indicated that oil prices are going down in 2014.

Figure 2. 2 Oil Prices in International Market from 1976 to 2014



Note: Data for Oil price taken from BP Statistical Review of World Energy (2016)

The figure 2.3 depicts the oil exports of Russia from year 1993 to 2015. There is positive trend of oil export but with little fluctuations. The exports have been started from 3,714 (thousand barrels daily) to 8,253 (thousand barrels daily) from year 1993 to 2015, so 122.19% growth in Russian oil export from years 1993 to 2015 has been observed.

Figure 2. 3 Oil Export for Russia, thousand barrels daily

Note: Data for Oil Exports taken from BP Statistical Review of World Energy (2016)

2.3 FINANCIAL SOCIAL ACCOUNTING MATRIX FOR RUSSIA

The initial concept of Social Accounting Matrix (SAM) has been introduced by Gregory King in 1681. After the King's seminal work, Richard Stone has worked on the linkage between the SAM and Cambridge Growth model[20] in the era of 1950s and 60s. Stone follows the 18th century methodology "tableau économique", proposed by the (Quesnay, 1758). Stone developed the structure of SAM in a modern way in his famous and most cited paper of 1954, "Input-Output and the Social Accounts". Stone has done outstanding work on the extension of national accounts under the world bank and developed the system of national accounts (SNA, 1968). The study of Stone used the "fixed price" multiplier models. In the era of 1970s, the studies of (Pyatt & Thorbecke,1976) and (Pyatt & Round, 1977) applied the Social Accounting Matrix on the economies of developing countries. The study of (Pyatt & Round, 1977) suggested the disaggregation of SAM for the developing countries and mentioned that the SNA is not supplying full information to construct the SAM for the developing countries. Similarly, the famous work in 1980s has been done by the (Khan & Thorbecke, 1988) on the inclusion of innovation and their linkage with the disaggregated form of informal sectors in Indonesian economy. The study of (Keuning, 1994 & 1997) extends the concept of SAM and developed the System of Economic and Social Accounting Matrices and Extensions (SESAME) for the Netherlands.

The studies for developing countries have been done by the researchers like, (Adelman & Taylor, 1990; Dorosh, 1994; Taylor & Adelman, 1996; Thorbecke & Jung, 1996; Khan, 1999; Bautista et al., 1999; Arndt et al., 2000 and Taylor et al., 2003). Similarly, other valuable studies of SAM have been done by (Khorshid, 1986; Khorshid et al., 1988; Khorshid, 2008; Pyatt & Round, 1985 and Stone, 1997).

Some studies build the SAM by following the input-output and construct the new data base which is called SAM and extended Input-Output tables (SAMIO) for the analysis of socio-economic issues, (Reich et al., 1977; Horz & Reich, 1982 and Reich, 1986). The study of (Stahmer, 2004) also mentioned the three different versions of SAIMO, which are consisted on time units, monetary units, and physical units. Recently, the study of (Round, 2003) mentioned the three key features of (SNA,1993), which play the key role in the SAM based on (SNA, 1993). The three primary features are as (i) Supply and Use Table (SUT), which is represented in a simplest portray of matrix accounts. SUT stands for the supply

[20]Cambridge, D. A. E. (1962). A programme for growth. *Vol. I: A Computable Model for Economic Growth*, *2*, 1954-1966.

and use of the product by activities. It demonstrates the income generation process for income by activities and then further the final use of products by different institutional sector. (ii) Integrated Economic Accounts (IEA) plays the leading role in the development of SNA, IEA is an amalgam of current, accumulation and assets for each institutional sector of the economy, for total economy and for rest of the world (ROW). (iii) Cross-Classification of Industry and Sector (CCIS), which is more flexible in nature and which is classified into three-way table. It is the implementation of Ghana statistics into (SNA,1993) and CCIS tables are adjustable into the SUT and further depicts the more disaggregation of activities by the different institutional sectors.

There are two main types of SAM. First, the macro or aggregated SAM and second one is known as disaggregated SAM. The study of (Francois & Reinert, 1997) analyzed that the Macro SAM is general level of SAM, which stands for the economy at aggregate level. It is without any more disaggregated form of accounts. On the other hand, the construction of disaggregated SAM is based on the micro SAM and represents the more disaggregated form of accounts. The IFPRI has done some work on the conversion of disaggregated SAM from micro SAM. The work of SAM for Bangladesh is the similar case (Fontana & Wobst, 2001).

Very few studies have been done by the researchers on Russian SAM. The study of (Kuboniwa & Mikheeva, 2004) compiled the aggregate SAM for Russia from year 1995-2001 and compiled the disaggregated SAM for year 2000. The aggregated SAM is based on three institutions like households, corporate enterprises, and the government. The aggregated SAM has been constructed by using the national accounts data set published by the *Goskomstat* of the Russian Federation. On the other hand, the disaggregated SAM used the data set of Russian IO tables for year 2000 and national household survey for 2000.

The current study is based on the construction of Financial Social Accounting Matrix (FSAM) for Russia (based on year, 2015), which is the first study for Russia. The researcher defined FSAM as "a combination of the flow-of-funds (FOF) and the social accounting matrix approaches to macroeconomics that provides details of the real-financial transactions and flows occurred between economic agents" (Emini & Fofack, 2004). The general SAM only represents the real side of economic flows but missed the financial side of economy, so that's why researcher felt to developed FSAM, which has capacity to represent real as well as financial side of economy. The researchers developed the Financial SAM for different countries like, (Emini & Fofack, 2004) for Cameroon; (Santos, 2007) for Portugal; (Aslan, 2007) for Turkey; (Hernández, 2008) for Colombia; (Li, 2008 and Liu et al., 2015) for China; (Waheed & Ezaki, 2008) for Pakistan; (Hubic, 2012) for Luxembourg; (Viet et al., 2013) for Philippines; (Helbig, 2013) for Germany; (Ayadi & Salem, 2014) for Tunisia and Aray et al. (2016) for Spain.

The researcher like (Wong & Lee, 2009) explained that the main difference between the SAM and the FSAM is the goal of the Capital Account (CC). The SAM's CC records the saving of the agents like (firms, households, and government) and it corresponds to the total investment of those agents in fixed assets or in other words, investments in gross fixed capital formation. On the other hand, FSAM (CC) allows the detail analyses to the amount of assets they hold either in fixed or financial. The Financial Account (FC) presents the detail characteristics and structures of the financial sources.

2.3.1 Advantages of Social Accounting Matrix

The Social Accounting Matrix consists on some important characteristics and same basic assumptions as the Input-output models. First, SAM is depicted in the tabular form and is the data set in a square matrix, where the rows are the income or receipts and the columns stand for the expenditures or outlays. Second, the aggregates of both of rows and columns are equals to each other, meaning thereby that expenditure should be equal to income. Third, both the numerical and algebraic representation of each SAM is possible. As the SAM is a first step to apply the Computable General Equilibrium (CGE), the numerical representation is more convenient to investigate the economic analysis, (Abbink et al., 1995). Fourth, SAM depicts the clear and broader picture between the relationship of income distribution and economic structure. Fifth, usually the outlay of SAM is based on different accounts like, (i) Production account (commodities and activities), (ii) institutional accounts (Household, Firms and Government) (iii) Factor of production accounts (iv) Capital accounts and (v) Rest of world accounts (ROW), (Fannin, 2000). Sixth, SAM stands for the flows of economic variables among the different agents of economic system for a specific time and usually it is yearly basis. Seventh, SAM is flexible in the sense that SAM can be constructed with respect to country, province, city, region, and village; it depends upon the availability of data.

2.3.2 Disadvantages of Social Accounting Matrix

There are also some disadvantages or limitations of SAM. The study of (Nijkamp, 2009) explained some disadvantages of SAM, First, the construction of SAM is time consuming, mostly based on micro-level survey data. Second, SAM model assumes that there are not any economies or diseconomies of production or factor substitution. Third, SAM is labor-intensive in nature and expensive to build. The main issue in the construction of SAM is to balance all the accounts of SAM. The researchers used different methods to balance the SAM. Some studies used the famous method known as Cross entropy (Robinson et al. 1998, 2001; Robinson & El-Said, 2001). On the other hand, some studies adopted the RAS technique to balance the SAM, (Bacharach, 1970); (Günlük-Şenesen & Bates, 1988); and (Gilchrist & St Louis, 1999).

2.3.3 Framework for Russian Financial Social Accounting Matrix

The Macro SAM for Russia has portrayed in the table 2.5, is based on the Micro level SAM for Russia. The first column C1 depicts the picture of total supply to domestic market. The cell [C1-R2] represents the domestic output w.r.t domestic market with 146,364,302 million rubles. The cell [C1-R6] represents the taxes less subsides on commodities with the amount of 8,466,222 million rubles. Similarly, the cell [C1-R11] represents the total imports for goods and services (including the direct purchase of residents abroad and adjustment of cif) in the economy with the amount of 17,142,903 million rubles. On the other hand, second column depicts the total domestic output, which shows the income flow from activities to commodities. The cell [C2-R1] depicts the total amount of total intermediate consumption with the monetary value of 71,446,132 million rubles. The other major portion of column represents the components of Gross value added. The cell [C2-R3] represents the flow of "compensation of employees" with the amount of 29,027,080 million rubles. The cell [C2-R4] represents the flow of "mixed income" including gross mixed income and gross operating surplus with 45,085,969 million rubles. The cell [C2-R5] represents "Other taxes less subsidies on production" with the monetary values of 805,123 million rubles.

The columns C3 to C5 stands for the primary income distributions (P1, P2 & P3) among the institutional sectors of current account. The column [C3-R10] stands for the labor endowments (P1) with 28,719,136 million rubles flow towards households and NPISHs (S14+S15). Similarly, the column [C3-R11] depicts the monetary flow of labor endowments of 521,206 million rubles towards the rest of the world (S2). The column [C4-R8], [C4-R9], [C4-R10] and [C4-R11] represents the flow of mixed income (P2) including gross mixed income and gross operating surplus with the monetary value of 22,055,889 million rubles;7,090,100 million rubles;14,071,388 million rubles, and 3,941,793 million rubles flow towards firms (S11+S12), Government (S13), households and NPISHs (S14+S15) and rest of the world (S2) respectively. The column [C5-R9] stands for the "other taxes less subsidies on production" (P3) with 805,123 million rubles of flow towards Government (S13).

The column [C6-R9] stands for the monetary flow of net taxes (taxes less subsidies on products) towards Government with the amount of 8,466,222 million rubles. The columns C8 to C11 stand for the secondary distribution of income among the institutional sectors. The columns [C8-R8], [C8-R9], [C8-R10] and [C8-R11] represent the monetary flow from firms to firms (S11+S12), Government (S13), households and NPISHs (S14+S15) and rest of the world (S2) with the amount of 643,059 million rubles, 3,165,204 million rubles, 1,506,988 million rubles and 960,456 million rubles respectively. Similarly, the columns [C9-R8], [C9-R10] and [C9-R11] are the monetary flow from Government to firms (S11+S12), households and NPISHs (S14+S15) and rest of the world (S2) with the amount of 2,045,311 million Rubles, 8,296,299 million Rubles and 973,027 million Rubles, respectively.

The columns [C10-R8], [C10-R9], [C10-R10] and [C10-R11] represent the monetary flow from the combination of households and NPISHs to firms (S11+S12), Government (S13), households and NPISHs (S14+S15) and the rest of the world (S2) with the amount of 514,480 million Rubles, 10,461,772 million rubles, 94,029 million Rubles and -714,311 million rubles respectively. On the other hand, the monetary flows in columns [C11-R8], [C11-R9] and [C11-R10] represents the transfers of money from the rest of the world (S2) to firms (S11+S12), Government (S13) and households and NPISHs (S14+S15) with the amount of -6,123,733 million rubles, 164,719 million rubles and 374,239 million rubles respectively. The columns [C11-R3] and [C11-R4] are the transfers of money from the rest of the world to Compensation of employees (P1) and mixed income including gross mixed income and gross operating surplus (P2) with the amount of 213,626 million rubles and 2,073,201 million rubles, respectively.

The columns [C9-R1], [C10-R1] and [C11-R1] are the monetary flow of final demands consumption from the institutional sectors like Government (S3), households and NPISHs (S14+S15) and rest of the world (S2) with the amount of 14,774,038 million rubles, 43,612,146 million rubles and 23,866,135 million rubles, respectively. Therefore, the columns [C8-R12], [C9-R13] and [C10-R14] and [C11-R15] represent the savings of institutional sectors like firms (S11+S12), Government (S13), households and NPISHs

(S14+S15) and rest of the world with the amount of 12,859,260 million rubles, 4,064,464 million rubles, 5,522,763 million rubles and -4,171,510 million rubles respectively.

The columns [C12-R1], [C13-R1] and [C14-R1] stand for the monetary flow of investment demand w.r.t institutional sectors like firms (S11+S12), Government (S3), households and NPISHs (S14+S15) with the amount of 10,114,608 million rubles, 3,316,030 million rubles and 3,545,078 million rubles, respectively. Whereas, the column [C16-R1] is the change in inventories with the monetary value of 1,299,260 million rubles.

The column [C12-R15] is the monetary flow from firms to rest of the world (S2) with the amount of 16,465 million rubles. The columns, [C13-R12], [C13-R13], [C13-R13] and [C13-R14] depict the monetary flow from Government (S13) to firms (S11+S12), Government (S3), households and NPISHs (S14+S15) and the rest of the world (S2) with the amount of 745,185 million rubles, 968 million rubles, 758,257 million rubles and -7,548 million rubles respectively. The column [C14-R15] is the monetary flow from households and NPISHs (S14+S15) to rest of the world (S2) with the amount of -1,056,098 million rubles.

The following tables (2.1, 2.2 & 2.3) depicts the Macroeconomic aggregates like Gross Domestic Product (GDP) w.r.t Expenditure, Production, and Income approach in millions of Rubles. All following facts have been extracted from the estimated Russian Financial Social Accounting Matrix for year 2015. The table 2.1 depicts total GDP at Expenditure approach stands for 83,384,392 million rubles. The estimation of GDP w.r.t Expenditure approach is the summation of the total Final consumption, changes in inventories, total Gross Fixed capital, and Net exports (Exports- Imports). The detail view of GDP by expenditure approach has been portrayed in appendix B-V (table 2.11).

Table 2. 1 GDP at Expenditure Approach at current prices (in Millions of Rubles)

Final Consumption Expenditure of Household & NPISHs	43,612,146
Final Consumption Expenditure of General Government	14,774,038
Changes in Inventories	1,299,260
Gross Fixed Capital Formation w.r.t Firms (FC+NFC)	10,114,608
Gross Fixed Capital Formation w.r.t General Government	3,316,030
Gross Fixed Capital Formation w.r.t HH+NPISHs	3,545,078
Exports of Goods and Services	23,866,135
Less Imports of Goods and Services	17,142,903
Gross Domestic Products w.r.t Expenditure Approach	83,384,392

The following table 2.2 depicts the GDP w.r.t production approach in millions of Rubles. The total GDP at production approach is 83,384,393 million rubles. The estimation of GDP w.r.t Production approach is the summation of Gross Value Added (Output of goods and services minus Intermediate consumption) and Net Taxes (Taxes-Subsidies) on products. The detail view of components of GDP by production approach (excluding net taxes) has been portrayed in appendix B-IV (table 2.10).

Table 2. 2 GDP at Production Approach at current prices (in Millions of Rubles)

Output of goods and services	146,364,302
Less (Intermediate Consumption)	71,446,132
Net Taxes (Taxes-Subsidies) on Products	8,466,222
Gross Domestic Products w.r.t Production Approach	83,384,393

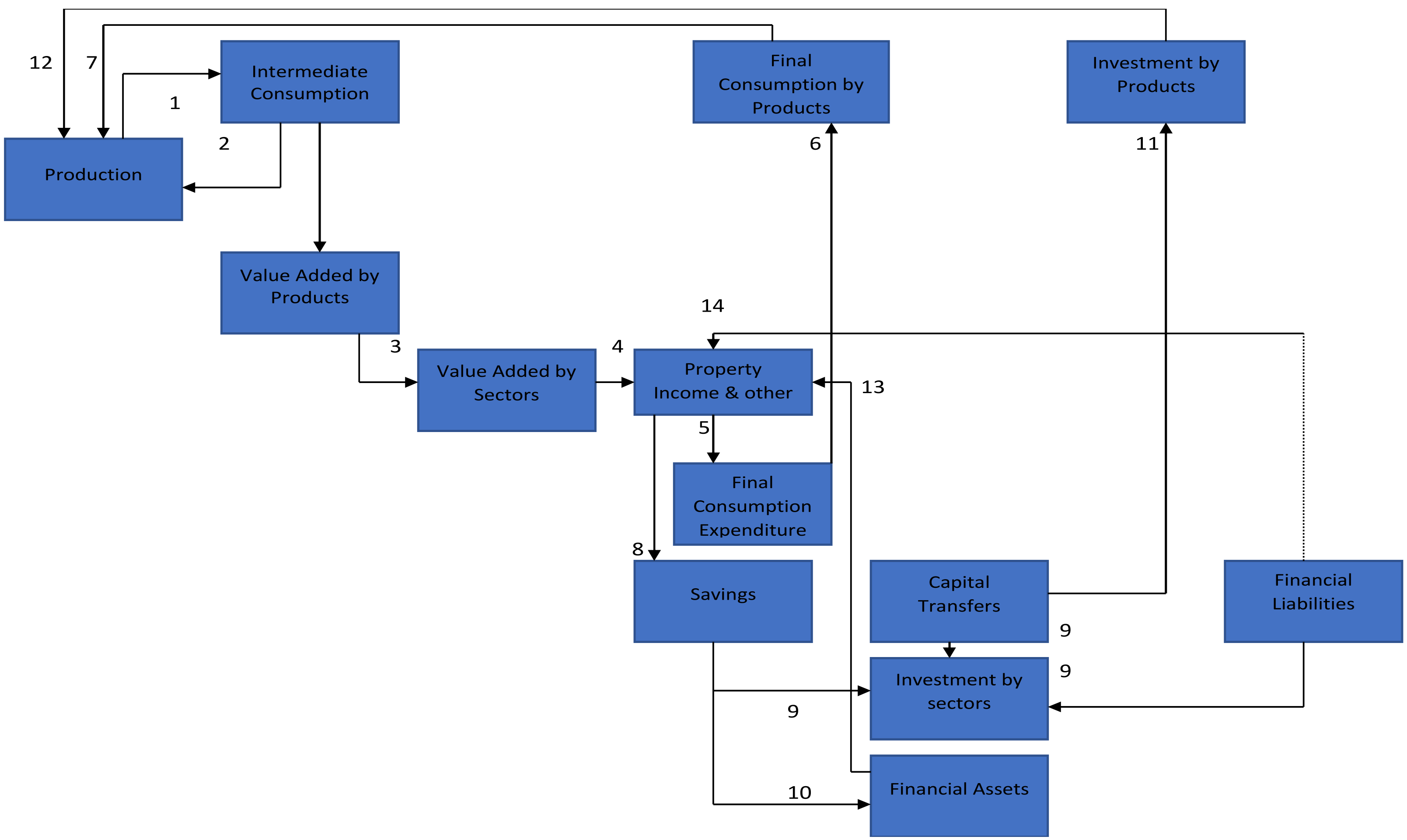
The following table 2.3 depicts the GDP w.r.t Income approach in millions of Rubles. The total GDP at Income approach stands for 83,384,394 million rubles. The estimation of GDP w.r.t Production approach is the summation of Gross Value Added (Compensation of Employees, Mixed Income including Gross operating surplus and Gross Mixed Income, other taxes less subsidies on production and Net Taxes (Taxes-Subsidies) on products.

Table 2. 3 GDP at Income Approach at current prices (in Millions of Rubles)

Compensation of Employees	29,027,080
Mixed Income (Gross operating surplus + Gross Mixed Income)	45,085,969
Other Taxes Less Subsidies on production	805,123
Net Taxes (Taxes-Subsidies) on Products	8,466,222
Gross Domestic Products w.r.t Income Approach	83,384,394

If we analyze all the three approaches of GDP in estimated SAM, all values are equal or there is minor difference due to different classification and sources of data. Usually this type of minor difference appears during the SAM balancing procedure.

Figure 2. 4 Circular Flow of Russian Financial Social Accounting Matrix (RFSAM)



Source: Income Flow of Financial Social Accounting Matrix (Aray et al, 2016)

Table 2. 4 Framework for Macro Financial Social Accounting Matrix (MFSAM) for Russia-Year 2015

		Outlays	Commodities	Production activities	Factors of Productions			Net Taxes	Trade and transport margins	Institutional Sectors of Current Account				Institutional Sectors of Capital Account				Ch. In Stocks	Financial instruments	Total
					P1	P2	P3	Taxes - Subsidies		Firms	Govt	HH+NPISHs	ROW	Firms	Govt	HH+NPISHs	ROW			
Revenues		n.	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18
Commodities		R1		Intermediate consumption							Final consumption by Govt	Final consumption by HH+NPISH	Exports	Investment demand w.r.t Inst Sectors				Inventories		Total demand
Production activities		R2	Domestic output w.r.t Domestic Market																	Domestic demand for domestic output
Factors of Productions	P1	R3		Gross value added									Factors income from ROW							Gross value added
	P2	R4																		
	P3	R5																		
Net Taxes	Taxes - Subsidies	R6	Taxes less subsidies on commodities																	Net taxes
Trade and transport margins		R7	Transaction costs																	Total trade and transport margins
Institutional Sectors Current Account	Firms	R8			Firms' income					Distributive transactions among institutional sectors										S11+S12 revenues
	Govt	R9			Govt Income			Net Taxes												S13 revenues
	HH+NPISHs	R10			HH+NPISHs income															S14+S15 revenues
	ROW	R11	Imports		ROW income															S2 revenues
Institutional Sectors Capital Account	Firms	R12								Firms Savings				Capital transfers among institutional sectors					Financial liabilities by institutional sectors	S11+S12 capital
	Govt	R13									Govt Savings									S13 capital
	HH+NPISHs	R14										HH+NPISHs Savings								S14+S15 capital
	ROW	R15											ROW Savings							S2 capital
Ch. in stocks		R16												Inventories by institutional sectors						Total changes in inventories
Financial instruments		R17												Financial assets by institutional sectors						Total financial assets
Total		R18	Total supply to the domestic market	Domestic output	Gross Value Added			Net Taxes	Total trade and transport	S11+S12 outlays	S13 outlays	S14+S15 outlays	S2 outlays	S11+S12 capital expenditures	S13 capital expenditures	S14+S15 capital expenditures	S2 capital expenditures	Total changes in inventories	Total financial liabilities	

Notations: P1-Compensation of Employees; P2-Gross Mixed Income + Gross Operating Surplus; P3-Other taxes less subsidies on production; NFC- Nonfinancial corporations (S11); FC- Financial corporations (S12); Govt-Government (S13); HH- Households (S14); NPSHs-Non-profit institutions serving households (S15); ROW-Rest of the world (S2)

Sources: Emini (2002), Hubic (2012) and author's construction

Table 2. 5 Macro Financial Social Accounting Matrix (MFSAM) for Russia- Year 2015

			Goods and services	Output	Income Generation					Institutions											
		Outlays	Commodities	Production	Factors of Productions			Net Taxes	Trade and transport margins	Institutional Sectors of Current Account				Institutional Sectors of Capital Account				Ch. in Stock	Total of Real SAM	Financial Account	Total SAM
								Taxes - Subsidies	Transaction Cost	Firms	Govt	HH+NPISH	ROW	Firms	Govt	HH+NPISH	ROW				
	Codes				P1	P2	P3			S11+S12	S13	S14+S15	S2	S11+S12	S13	S14+S15	S2				
Revenues		n.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Commodities		1	0	71446132	0	0	0	0	0	0	14774038	43612146	23866135	10114608	3316030	3545078	0	1299260	171973426	0	171973426
Production		2	146364302	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	146364302	0	146364302
Factors of Production	P1	3	0	29027080	0	0	0	0	0	0	0	0	213262	0	0	0	0	0	29240342	0	29240342
	P2	4	0	45085969	0	0	0	0	0	0	0	0	2073201	0	0	0	0	0	47159170	0	47159170
	P3	5	0	805123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	805123	0	805123
Net Taxes	Taxes - Subsidies	6	8466222.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8466222	0	8466222
Transaction Cost		7	-0.0890202	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Firms	S11+S12	8	0	0	0	22055889	0	0	0	643059	2045311	514480	-6123773	0	0	0	0	0	19134967	0	19134967
Govt	S13	9	0	0	0	7090100	805123	8466222	0	3165204	0	10461772	164719	0	0	0	0	0	30153140	0	30153140
HH+NPISH	S14+S15	10	0	0	28719136	14071388	0	0	0	1506988	8296299	94029	374239	0	0	0	0	0	53062079	0	53062079
ROW	S2	11	17142903	0	521206	3941793	0	0	0	960456	973027	-7143111	0	0	0	0	0	0	16396275	0	16396275
Firms	S11+S12	12	0	0	0	0	0	0	0	12859260	0	0	0	0	745185	0	640712	0	14245157	15112859	29358016
Govt	S13	13	0	0	0	0	0	0	0	0	4064464	0	0	0	968	0	-1517944	0	2547488	861920	3409408
HH+NPISH	S14+S15	14	0	0	0	0	0	0	0	0	0	5522763	0	0	758257	0	-5546	0	6275474	-525120	5750354
ROW	S2	15	0	0	0	0	0	0	0	0	0	0	-4171510	16465	-7548	-1056098	2387	0	-5216304	-17579	-5233882
Ch. in Stock		16	0	0	0	0	0	0	0	0	0	0	0	1251187	0	48003	70	0	1299260	0	1299260
Total of Real SAM		17	171973427	146364303	29240342	47159170	805123	8466222	0	19134967	30153140	53062079	16396274	11382260	4812892	2536982	-880321	1299260			0
Financial Account		18	0	0	0	0	0	0	0	0	0	0	0	17975756	-1403484	3213372	-4353562	0	15432081	0	15432081
Total SAM		19	171973427	146364303	29240342	47159170	805123	8466222	0	19134967	30153140	53062079	16396274	29358016	3409408	5750354	-5233883	1299260	15432081	0	

2.3.4 Blocks of Financial Social Accounting Matrix

This section depicts the different blocks used in the construction of current Financial Social Accounting Matrix for Russia.

i. The Block of Intermediate Consumption
ii. The Block of total Output of Industries
iii. The Block of Gross Capital Formation
iv. The Block of Net Taxes on Production
v. The Block of Net Taxes on Products
vi. The Block of Final Consumption
vii. The Block of External Trade
viii. The Block of Trade and Transport Margins
ix. The Block of Current Transfers
x. The Block of Gross Savings
xi. The Block of Capital Transfers
xii. The Block of Financial Transactions

i. Block of Intermediate Consumption:

The column [C2-R1] in the table 2.4 of Macro SAM is representing the intermediate consumption (transaction P2 in National Accounts) of commodities, which is used as an input in the production process excluding the fixed assets which are already recorded in the consumption of fixed capital. The intermediate consumption obtained from the Use table is released by the official statistics Bureau, *Russian Federal State Statistics Services* (ROSSTAT). The intermediate consumption extracted with respect to purchases prices. The detailed view of Intermediate consumption has presented in appendix B-II (table 2.8).

ii. Block of Total Output:

The column [C1-R2] in the table 2.4 of Macro SAM is representing the total amount of output for goods and services (transaction P1 in National Accounts) driven from the Make table. The Make table is derived by taking the transpose of Supply table. The detailed view of total output has been presented in appendix B-III (table 2.9).

iii. Block of Gross Capital Formation:

The columns [C12-R1, C13-R1, C14-R1, and C16-R1] in the table 2.4 of Macro SAM are the Gross capital formation (transaction P5 in National Accounts), which consist of gross fixed capital formation, changes in inventories, acquisitions less disposals of valuables (subsections as P51, P52 and P53 respectively in National Accounts). The total gross capital formation by products has been calculated from the Use table. The detailed view of Gross Fixed Capital and Inventories has been presented in appendix B-VII (table 2.13) and appendix B-VIII (table2.14) respectively.

iv. Block of Net Taxes on Production:

The column [C1-R6] in the table 4 of Macro SAM is representing the net taxes (other taxes less subsidies on production). Net taxes on production are other taxes less subsidies on production (transaction D29-D39 in National Accounts). The former "other taxes on production" consists of all taxes paid by firms to government due to their engagement in production process, regardless of value or quantity of goods and services produced or sold. The latter "other subsidies on production" consists of subsidies of production, (ISWG, 93 & ESA, 95). The net taxes on production exist in Primary distribution of income accounts of the institutions (generally, II.1., in integrated economic accounts).

v. Block of Net Taxes on Products:

The column [C6-R9] in the table 2.4 of Macro SAM stands for the Net taxes on product, taxes less subsides on products (transaction D21-D31 in National Accounts). The former "taxes on product" consists of payable taxes on per unit of good or service produced or transacted to the government and the rest of the world, (ISWG, 93 & ESA, 95). The latter consists of "subsidies on products" that is payable per unit of a good or service produced or imported and received from the government and the rest of the world,(ISWG, 93 & ESA, 95).This block exists in Production account and primary distribution of income accounts of institutions (I and II.1, in integrated economic accounts or supply of products at basic prices (current prices).

vi. Block of Final Consumption:

The columns [C9-R1 and C10-R1] in the table 2.4 of Macro SAM stand for the Final consumption by government and HH+NPISHs, respectively. Final consumption (transaction P3 in National Accounts) consists of expenditure incurred by resident institutional units on goods or services that are used for the direct satisfaction of individual needs, wants or the collective needs of members of the community, (ISWG, 93 & ESA, 95). The detailed view of Final consumption by government and HH+NPISHs has been presented in appendix B-VI (table 2.12).

vii. Block of External Trade:

The columns [C11-R1 and C1-R11] in the table 2.4 of Macro SAM are the total exports of goods and services and imports, respectively. There are transactions in goods and services (purchases, barter, gifts, or grants) from non-residents to residents, or imports (transaction P7 in the National Accounts) and from residents to non-residents, or exports (transaction P6 in the National Accounts). Although the National Accounts consider direct purchases abroad by residents as an import, here they are considered as a current transfer from households to the rest of the world, (ESA, 95). The detailed view of External trade has been presented in appendix B-IX (table 2.15).

viii. Block of Trade and Transport Margins:

Trade and transport margins consist on the goods, which purchased for resale and part of the production of the wholesale trade services, retail trade services and repair services of motor vehicles, motorcycles, and personal and household goods. The total of trade and transport margins should be zero because the negative and positive values are offsetting each other (ESA, 95).

ix. Block of Current Transfers:

Current taxes on income, wealth, etc. (transaction D5 of the National Accounts), which cover all compulsory, unrequited payments, in cash or in kind, imposed periodically by government and by the ROW on the income and wealth of institutional units, also covered periodic taxes, which are imposed on neither income nor wealth, (ISWG, 93 & ESA, 95). Also included the Social benefits and contributions (transaction D6 of the

National Accounts), which are transfers to households in cash or in kind, intended to release them of the financial burden of several risks or needs, made through collectively organized schemes or by government and non-profit institutions serving households. Social contributions include (employers' and employees') actual social contributions transferred to government, (ISWG, 93).

Other current transfers (transaction D7 of the National Accounts) consist of net non-life insurance premiums, non-life insurance claims, current transfers within government, current international co-operation, and miscellaneous current transfers, (ISWG, 93). Adjustment made for the change in the net equity of households in pension fund reserves (transaction D8 of the National Accounts), which consist of those adjustment needed to appear in the saving of households. The change in the actuarial reserves on which households have a definite claim are fed by premiums and contributions recorded in the secondary distribution of income account as social contributions, (ISWG, 93). Usually extraction of Current account is based on “from whom to whom” matrix.

x. Block of Gross Savings:

Gross saving (B.8g in National Accounts) measures the part of the aggregate income that is not used for final consumption expenditure and current transfers to Russian institutions or to the rest of the world.

xi. Block of Capital Transfers:

Capital transfers (transaction D9 in the National Accounts) consist of capital taxes, investment grants and other capital transfers, (ISWG, 93). Acquisitions less disposals of non-financial non-produced assets (transaction K2 in the National Accounts) -non-financial non-produced assets consist of land and other tangible non-produced assets that may consist of the production of goods and services, as well as intangible non-produced assets, (ISWG, 93). The extraction of Capital transfer is also based on “from whom to whom” matrix.

xii. Block of Financial Transactions:

Financial transactions (F1-7 in the National Accounts) are transactions, which consists of T account of financial assets and liabilities between institutional sectors, and further between institutional sectors and the rest of the world. Financial transactions are classified as monetary gold and special drawing rights; currency and deposits; securities other than shares; loans; shares and other equity; insurance technical reserves; and other accounts receivable/payable. The outlays (expenditures) side of the (financial) account records changes in the assets, i.e. acquisitions minus disposals of financial assets. The incomes (receipts) side of the same account records changes in liabilities and net worth, i.e. the incurrence of liabilities minus their repayment. The balancing item of the financial account, i.e. the net acquisition of financial assets minus the net incurrence of liabilities, is net lending (+)/net borrowing (-), (ISWG, 93). The extraction of Financial transfer is also based on Financial "from whom to whom" matrix.

2.3.5 Balancing Procedure of Social Accounting Matrix

There are several techniques for balancing the SAM which have been used by the different studies like (Robinson et al.,1998) proposed Cross entropy approach; (Stone-Byrone, 1977 & 1978) proposed Generalized Least Square (GLS) method; (Davis et al., 1977) proposed Linear programing SAM balancing method; (Lugovoy et al., 2012) proposed Bayesian technique; (Scandizzo & Ferrarese, (2015) proposed mixture of Entropy minimization and Monte Carlo simulation techniques for SAM balancing; (Lee & Su, 2015) proposed mathematical optimization method and general algebraic modeling system; (Zenios et al., 1989) proposed nonlinear network programming for balancing large SAM; (Round, 2003; Ahmed & Preckel, 2007), etc. Now a day, the balancing of SAM is gaining more importance because the for more disaggregated level of SAM needs bulk of data sets, so due to various sources of data, the data sets are inconsistent with national accounts. There is need to balance the SAM by using those techniques, which give the accuracy among the inconsistent sets of data in SAM. The current study used the RAS method but with the adjustment of economic integration of different accounts. The RAS method is extensively used method for balancing the SAM and proposed by novel economist "Richard Stone", RAS method is only applicable if, we know the economic integration (meaning that researcher should know the total sum of columns and rows). The following RAS method has been taken from Lemelin et al. (2013).

$$T_j = \sum_i t_{ij} \qquad (a)$$

The term T_j is denoting the new transaction matrix with t_{ij} cells that satisfies the condition of new coefficient A matrix, which can be generated by dividing each cell of T_j by dividing the total sum of column.

$$a_{ij} = \frac{t_{ij}}{t_{.j}} \qquad (b)$$

The most common approach for the extraction of new matrix A^1 by using the old matrix A^0 by adopting the biproportional approach (rows and columns operations).

In the matrix notation:

$$A^1 = RA^0S \qquad (c)$$

The term A^0 is denoting the diagonal matrix of R and S .

The RAS method is iteration method as following:

Step-I:

$$a_i^1 = \frac{\overset{\wedge}{x_i}}{\sum_j x^0{}_{ij}} \quad \Rightarrow x_{ij}^1 = a_i^1 x_{ij}^0 \quad \Rightarrow b_j^1 = \frac{\overset{\wedge}{x_j}}{\sum_j x^1{}_{ij}} \quad \Rightarrow \quad x_{ij}^2 = b_i^1 x_{ij}^1$$

Step-II:

$$a_i^2 = \frac{\overset{\wedge}{x_i}}{\sum_j x^2{}_{ij}} \quad \Rightarrow x_{ij}^3 = a_i^2 x_{ij}^2 \quad \Rightarrow b_j^2 = \frac{\overset{\wedge}{x_j}}{\sum_j x^3{}_{ij}} \quad \Rightarrow \quad x_{ij}^4 = b_i^2 x_{ij}^3$$

Step-t:

$$a_i^t = \frac{\overset{\wedge}{x_i}}{\sum_j {x_{ij}}^{2t-2}} \quad \Rightarrow x_{ij}^{2t-1} = a_i^t x_{ij}^{2t-2} \quad \Rightarrow b_j^t = \frac{\overset{\wedge}{x_i}}{\sum_j {x_{ij}}^{2t-1}} \quad \Rightarrow \quad x_{ij}^{2t} = b_i^t x_{ij}^{2t-1}$$

The iteration process is continued till the completion of iteration process. The advantage of RAS method is simple in performing the SAM balancing. RAS method has some disadvantages as: (1) lack of economic foundations (2) inability to accommodate the new unknown cells (3) Not performing in the existence of zero values and (4) Not performing in the existence of negative values.

The current study has avoided the zero and negative values. Normally during the balancing process, researcher found negative values in investment, subsidies, trade margins and imports, etc. We can take the transpose of negative values to their counterpart cells before balancing the SAM. In this way, SAM stands for the flow from one account to another. The negative flow from cell A to cell B is equal to positive flow from cell B to cell A. If a negative value appears in the position (1,2) then we can instead put the absolute value in position (2,1). If necessary for any SAM based model, then we can restore it to its original position after adjustment.

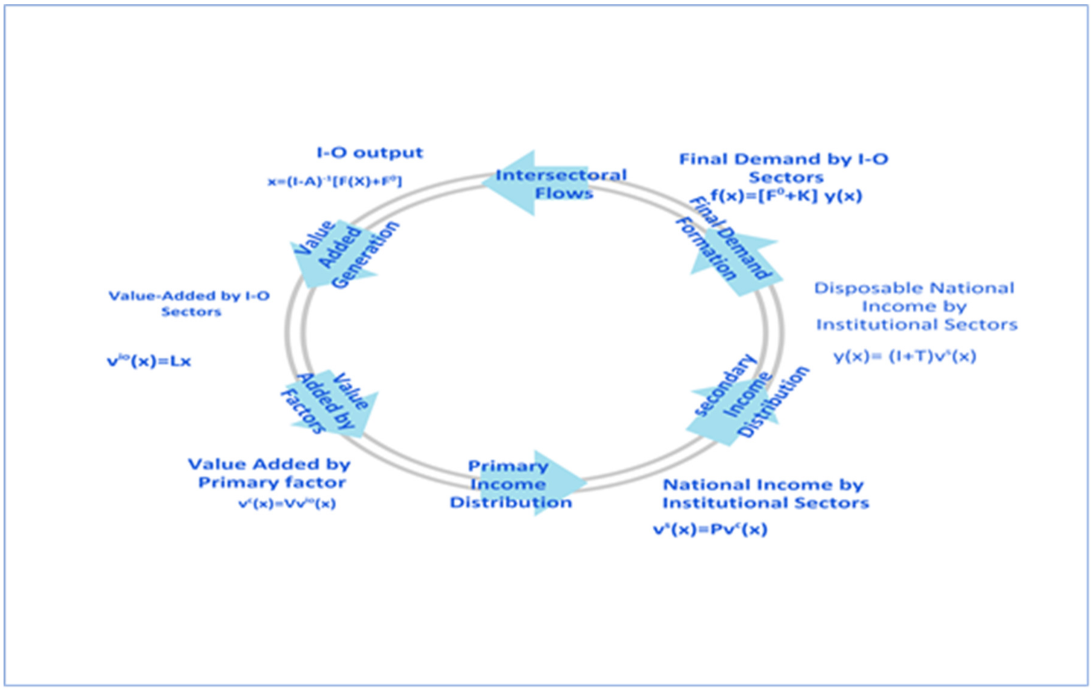
2.4 METHODOLOGY

2.4.1 Multi-Sectoral Methodology for Oil and Gas Sector

The existing study analyzes the multi-industry, multi-factor, and multi-sector model, which is based on Miyazawa approach (Bulmer & Thomas, 1982; Miller & Blair, 2009; Miyazawa, 1976). There are lot of studies on SAM based multiplier for different economies like (Pyatt & Round, 1979) for Sri Lanka; (Hayden & Round, 1982) for Botswana; (Defourny & Thorbecke, 1984) for Korea; (Forssell, 1988) for Finland; (Urata, 1988) for Soviet economy; (Skolka, 1989) for Austria; (Lee, 1990) for USA; (Matallah & Proops, 1992) for Algeria and (Siddiqui & Iqbal, 1999) for Pakistan. The current study is based on Macro Multiplier (MM), which is presenting the extended form on circular flow of income (Ciaschini & Socci, 2007a; 2007b). The MM approach assumes the constant prices as well as constant technical co-efficient and their corresponding shares.

The figure 2.5 depicts the whole income generation and distribution among the industrial sectors, institutional sectors, and factors of production. The figure 2.5 stands for the feedback loop between the output of industries and final demand. The figure 2.5 is whole income generation and distributional process into five phases. In Phase-I, whenever the production process started in different industries, we get output, x, which further generates the gross value added, $v(x)$, (GVA generation). Phase-II generates the c value added components, $v^c(x)$ generation of value by m I-O industries (Gross value-added allocation). Phase-III creates the loop for the allocation of value added by components to s institutional sectors, $v^s(x)$ (Primary distribution of income). Phase-IV further generates the second income distributions among the institutional sectors through taxation to generate disposable incomes by the s institutional sectors, $y(x)$. Finally, institutional sectors generate the disposable income by using the proper set of final demand, which further creates, $f(x)$, (Final demand formation).

Figure 2. 5 Extended form of Multi-Sectoral Extended model



2.4.2 Mathematical Modelling for Multi-Sectoral Methodology

The current section is depicting the extended Multi-Sectoral model that can be particularized with the following fundamental equations and adopted from (Ciaschini & Socci, 2007a; 2007b).

$$x+m=B.i+f \qquad [1]$$

The L.H.S of equation [1] is a summation of x+m, where x represents the output vector of included industries, m is imports vector, on the other hand, R.H.S represents the B_i+f, where matrix B is intermediate consumption and f if the final demand vector. In current method, the final demand employees as endogenous variable and determination of exogenous final demand is determined by the distributive structural matrices. The figure 2.5 depicts the following mathematical model:

a. Generation of Gross value-added (by industries)

$$v(x)=L.x \qquad [2]$$

By using the obtained output vector and technical coefficients matrix, we get L[m, m] value added shares by industry.

b. Allocation of Gross value-added (by VA components)

$$v^c(x)=V.v(x) \qquad [3]$$

Where the term V[c, m] is the allocation of value added to the value-added components.

c. **Primary distribution of income (by institutional sectors)**

$$v^s(x)=\text{P}.\text{v}^c(x) \qquad [4]$$

Where the term $P\ [s, c]$ is the distribution of factors of production, which further creates the value-added income for the institutional sectors.

d. **Secondary distribution of income (by institutional sectors)**

$$y(x) = (\text{I+T})\text{P}.\text{v}^s(x) \quad [5]$$

Where term $T[s, s]$ refers to the distribution of net income transfers among the institutional sectors.

e. **Final demand formation (by industries)**

$$f(x)=\text{F}^0.\text{y}(x)+\text{K}.\text{y}(x)+\text{f}^0 \quad [6]$$

where F^0 represents the structure of consumption demand w.r.t industries and extracted by the product of two matrices, $F^0=\text{F}^1.\text{C}$, where F^1[m,s] transformation of consumption expenditures by institutional sectors into consumption by industries and $C[s, s]$ represents the consumptions propensities by institutional sectors.

The matrix K represents the shares of investment demand and extracted by $K = K^1.s.$(I-C),where K^1[m,s] characterizes the investment demands w.r.t I-O industries and scalar S represents the share of private savings, which is transformed into investment considered as 'active savings'. The term f^0 is a vector of m elements, which characterizes the exogenous demand (exports).

By using F=[F^0+K], equation [6] becomes

$$f(x) = \text{F}.y(x) + \text{f}^0 \qquad [7]$$

By substituting the equation [2] & [6] into equation [7], we get

$$f(x)=\text{F}.[\text{I+T}].\text{P.V.L.x}+\text{f}^0 \qquad [8]$$

The output generation process showed by equation [1] is given as

f. **Output generation**

$$x + m = A.x + f(x) \qquad [9]$$

where x and m represent output vector and imports respectively, **A** is technical coefficient matrix and f(x) refers to the final demand vector.

Substituting the equation [8] into equation [9], we have;

$$\text{x}=[\text{I-A-}(F).(\text{I+T}).\text{P.V.L}]^{-1}.(f^0\text{-m}) \qquad [10]$$

2.4.3 Dispersion Approach

From equation [10], we have the structural matrix **R** which helps quantify the direct and indirect effects of final demand on total output.

$$R=[I-A-(F).(I+T).P.V.L]^{-1} \qquad [11]$$

The linkage analysis can be expressed in the Hirschman's conception, "as the attempt to discover how one thing leads to another" (Hirschman, 1981). There are many studies like (Rasmussen, 1956); (Chenery & Watanabe, 1958); (Hirschman, 1958); (Augustinovics, 1970); (Laumas, 1975), and (Lenzen, 2003) which contributed in the literature of linkage analysis. By using the R matrix, we can analyze the direct as well as indirect linkages effects by adopting the (Rasmussen, 1956) method. The forward and backward linkages also called the index of sensitivity of dispersion (Ciaschini & Socci, 2007b; Dettmer & Fricke, 2014).

The total backward linkages of sector j are the sum of columns of Leontief inverse L, (Miller & Blair, 2009). For better comparison of sectoral backward linkages, the normalization is important, (Miller & Blair, 2009). The backward linkages reflect the effects of increase in final demand of sector j on overall output. The power of dispersion index method has been adopted from (Ciaschini et al., 2009). The power of dispersion index can be expressed as:

$$\pi_j = \frac{\frac{1}{m.r_j}}{\frac{1}{m^2}.\sum_{j=1}^{m} r_j} \qquad [12]$$

The term m is standing for the no of commodities. The term $\sum_{j=1}^{m} r_j$ denoting the sum of all backward linkages.

The total forward linkages of sector i are the sum of rows of Leontief inverse L, (Miller & Blair, 2009). The term $\sum_{i=1}^{m} r_i$ denoting the sum of all forward linkages. The (Rasmussen, 1956) forward linkage (sensitivity index) shows the one monetary unit increase in the value of the primary inputs of sector i would affect the value of output produced by all the other sectors in the economy. The sensitivity of dispersion index can be expressed as:

$$\pi_i = \frac{\frac{1}{m.r_i}}{\frac{1}{m^2}.\sum_{i=1}^{m} r_i} \qquad [13]$$

The study of Cai et al. (2006) describes the four categories about the strength and weakness of backward and forward linkages, which has been described in the following table 2.6.

Table 2. 6 Strength and Weakness of Backward and Forward Linkages

Strengths and Weakness of BL and FL	***Size of BL and FL***	
Strong backward and forward Linkages	BL>1	FL>1
Strong backward but weak forward Linkages	BL>1	FL<1
Weak backward but strong forward Linkages	BL<1	FL>1
Weak backward and forward Linkages	BL<1	FL<1

2.4.4 SAM based Macro Multiplier approach: relationship between final demand and output

The R matrix can be decomposed into several sums of **m** matrices by adopting the approach of singular value decomposition (SVD), (Ciaschini et al., 2006). The approach of SVD can be applied on both square and non-square matrices. The present study adopted the version of square matrix for SVD technique. Simply, by using the 2x2 matrix of W[2,2]. The matrix W is consisted on the multiple combination of matrix R and transpose of R^T matrix.

$$W=R^T.R \qquad [14]$$

The Matrix W is based on positive definite (symmetric matrix with all positive eigenvalues), or semi definite square root. Therefore, the matrix $W \geq 0$ with all real non-negative eigenvalues λ_i for $i = 1,2$ (Lancaster & Tiesmenetsky, 1985). The eigenvectors for W and W^T are respectively $[u_i \, i = 1,2]$ and $[v_i \, i = 1,2]$ are based on orthonormal. We have

$$R^T u_i = \sqrt{\lambda_i} v_i \qquad [15] \qquad i = 1,2$$

The eigenvectors U and V for matrixes W and W^T may be constructed as

The two matrices can be constructed as

$$U=[u_1,u_2] \qquad [16] \quad \text{and} \qquad V=[v_1,v_2] \qquad [17]$$

Under the above said definition, the eigenvalues for matrix W coincide with singular values of matrix R, so $s_i = \sqrt{\lambda_i}$and we attain the following matrices.

$$R^T.U=[s_1.v_1,s_2,v_2]=V.S \qquad [18]$$

Structural matrix R in equation [11] can now be decomposed as

$$x = U.S.V^T.f \qquad [19]$$

V is an [2,2] unitary matrix, whose columns characterize the 2 reference structures for final demand:

$$v_1 = [v_{1,1} v_{1,2}] \qquad [20a] \text{ and } v_2 = [v_{2,1} v_{2,2}] \qquad [20b]$$

U is an [2,2] unitary matrix, whose columns characterize 2 reference structures for output:

$$u_1 = \begin{bmatrix} u_{1,1} \\ u_{1,2} \end{bmatrix} \qquad [21a] \quad \text{and} \quad u_2 = \begin{bmatrix} u_{2,1} \\ u_{2,2} \end{bmatrix} \qquad [21b]$$

On the other hand, S is an [2,2] diagonal matrix of the type:

$$S = \begin{bmatrix} s_1 & 0 \\ 0 & s_2 \end{bmatrix} \qquad [22]$$

The Scalars si mentioned in equation [25] are all real and positive and can be ordered as $s_1 > s_2$. The set of equations from [11] to [25] are enough to fulfill the construction and decomposition of MM that quantify the aggregate effect of any fluctuation in the final demand on output. The vector f given in equation [19] may be expressed in terms of structures found by matrix V, we get new final demand vector f^0 that is characterized in terms of the structures explained by matrix R:

$$f^0 = V.f \qquad [23]$$

Therefore, the total output x can be expressed under the given structure of matrix R:

$$x^0 = U^T.x \qquad [24]$$

By putting the values of equation [25] and [26], the equation [19] can be expressed as

$$x^0 = S.f^0 \qquad [25]$$

Which implies,

$$x_i{}^0 = s_i.f_i{}^0 \qquad [26]$$

The matrix R is also consisted on two hidden essential combinations of output (x). Hence, each of combination has been derived out by multiplying the respective combination of final demand (F) by a predetermined scalar, which plays significant role in the aggregation process of macro multiplier (MM). The equation [26] showed that by multiplying the term s_i, the complex effect on the output vector of final demand can be reduced.

The above said structure has well designed all potential behavior of system and all shocks can be captured by this method. The MM approach easily captured all the effect of final demand on output in whole economic structure.

The convenient way to capture the impact of final demand on output through MM approach is by organizing the equation [19] in such a way, supposed the vector f is any constant, say equal to one. So, vector f in equation [19] can be described as:

$$\sqrt{\sum_j f_j^2} = 1 \qquad [27]$$

Equation [27] implies that the final demand vector depicts a sphere of unit radius, standing for the unit circle. The ellipsoid shape shows the change in output effected by the final demand.

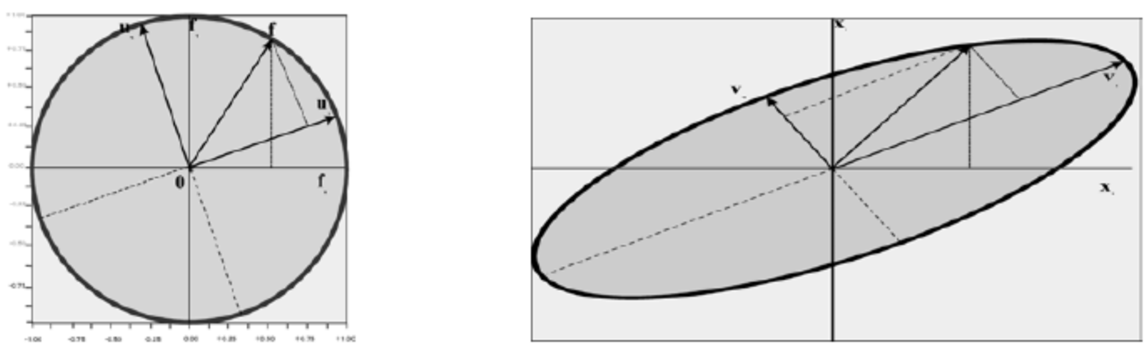
$$f^{*}=\alpha+v_1 + (1-\alpha)v_2 \qquad [28], \text{ where coefficient } \alpha, (0 \leq \alpha \leq 1)$$

Its effect on total output will be showing same combination,

$$x^{*}=\alpha[s_1 u_1] + (1-\alpha)[s_2 u_2] \qquad [29]$$

then it implies that the final demand vector presents a sphere of unit radius, the unit circle.

Figure 2. 6 Unit circle and corresponding ellipsoid for disposable income



a) changes final demand b) corresponding changes output industry

Source: Ciaschini & Socci (2007a)

The left panel of Figure 2.6 depicts that final demand rotates around the origin by assuming all structure including the column vector of V. On the other hand, the right panel of figure 3 showed that corresponding vector of total output present is working as an ellipsoid, with semi-axes of length s_1, s_2, concerned with the directions appointed by the columns of matrix U. This ellipsoid depicts the change in output effected by the final demand.

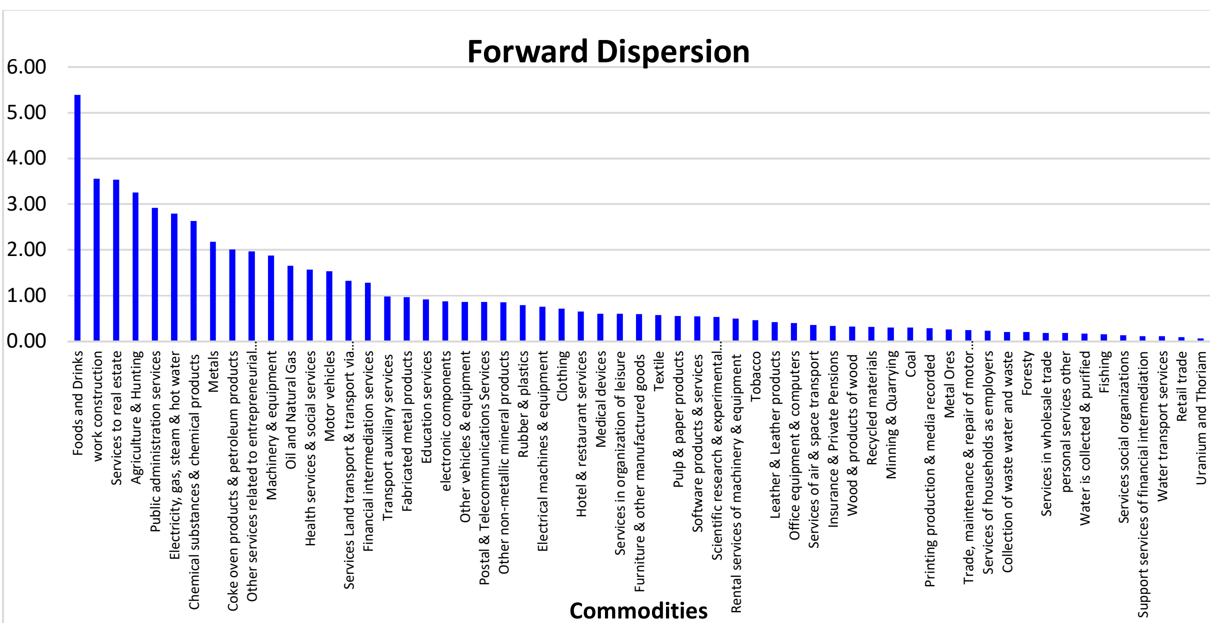
As the final demand vectors approaches a structure in V, the vector of total output crosses the corresponding structure in U and the ratio between the moduli of the two vectors is given by the corresponding scalar s. Singular values si then determine the aggregated effect of a final demand shock on output and for this reason it is called a macro multiplier effect. The macro multipliers (MM) are aggregated as each of them applies on all components of each macroeconomic variable taken into consideration and are consistent with the multi-industry specification of the model.

The model employed in current study enables the matrix R to isolate impacts of different (aggregated) size since it characterizes MM: a shock in final demand structure vi activates si which is explained in the impact on output structure ui.

2.5 EMPIRICAL ANALYSIS OF DISPERSION APPROACH

The figure 2.7 depicts the index of sensitivity dispersion with respect to commodities arranged according to their corresponding rankings (descending to ascending order). The commodity like 'Food and drinks' is showing the highest ranked with the index of 5.38; similarly the 'construction work' with index value 3.55 (rank 2); 'Services to real states' with index value 3.53 (rank 3); 'Agriculture & Hunting' with index value 3.25 (rank 4); 'Public Administration services' with index value 2.92 (rank 5); 'Electricity, gas, steam & hot water' with index value 2.79 (rank 6); 'Chemical substances & chemical products' with index value 2.63 (rank 7); 'Metals with index value 2.17 (rank 8); ' Coke oven products & petroleum products' with index value 2.00 (rank 9); 'Other services related to entrepreneurial activity' with index value 1.96 (rank 10); 'Machinery & equipment' with index value 2.00 (rank 11); 'Oil and Natural Gas' with index value 2.00 (rank 12); 'Health services & social services' with index value 2.00 (rank 13); 'Motor vehicles' with index value 2.00 (rank 14); 'Services Land transport & transport via pipelines' with index value 2.00 (rank 15); 'Financial intermediation services' with index value 2.00 (rank 16).All above ranks, which have higher index value than 1 shows the strong forward linkages. The rest of all commodities index values are less than 1, which shows the weak forward linkages. There is no any evidence of unitary index in the case of forward dispersion because any index value is equal to 1.

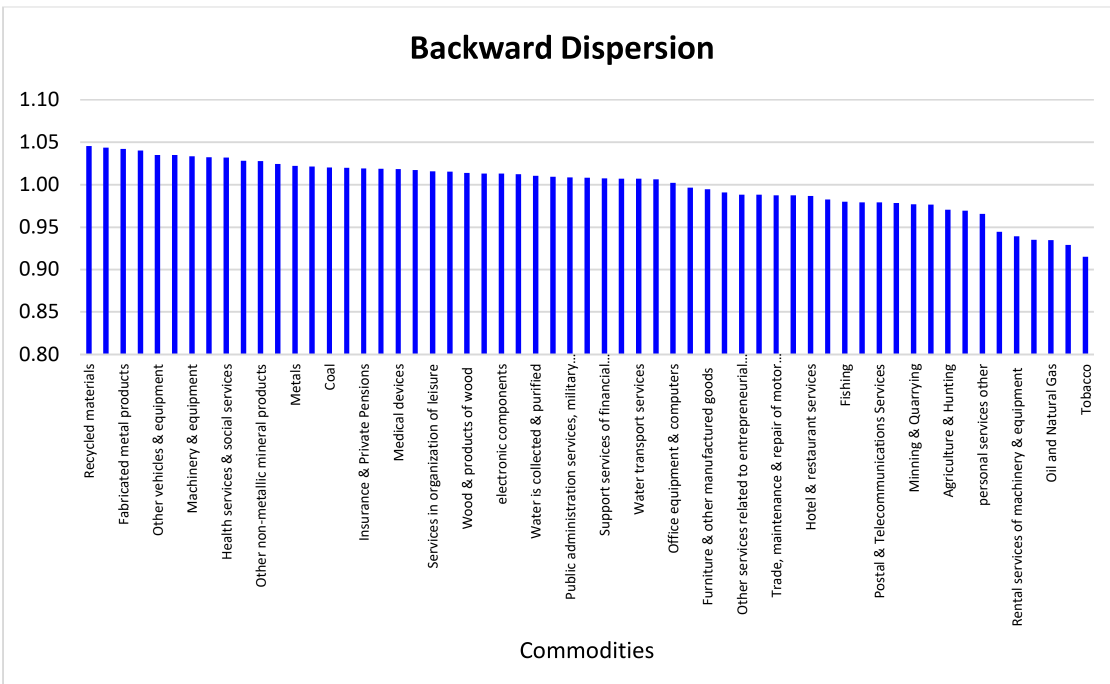
Figure 2. 7 Forward Dispersion with respect to Ranks



The detail view of forward linkages and dispersion for Russian commodities has been portrayed in appendix B-X (table 2.16).

The figure 2.8 depicts the index of power of dispersion with respect to commodities arranged according to their corresponding rankings (descending to ascending order). The commodity like ‘Recycled Materials’ is showing the highest ranked with the index of 1.045, in short the index values from rank 1 to 35 represents strong backward linkages because the index values are greater than 1. The rest of all commodities from rank 36 to 59 index values are less than 1, which shows the weak backward linkages. The unity value stands for the average index value. There is not any evidence of unitary index in the case of backward dispersion because any index value is equal to 1.

Figure 2. 8 Backward Dispersion with respect to Ranks



The detail view of backward linkages and dispersion for Russian commodities has been portrayed in appendix B-X (table 2.16). Both energy-oriented industries are fulfilling the condition of key industries (FD>1, BD>1) and can play important role in the development of Russian economy and can further boost the other industries. The results of current study are consistent with the previous study like (San Cristobal & Biezma, 2006).

2.6 EMPIRICAL ANALYSIS OF MACRO MULTIPLIER APPROACH

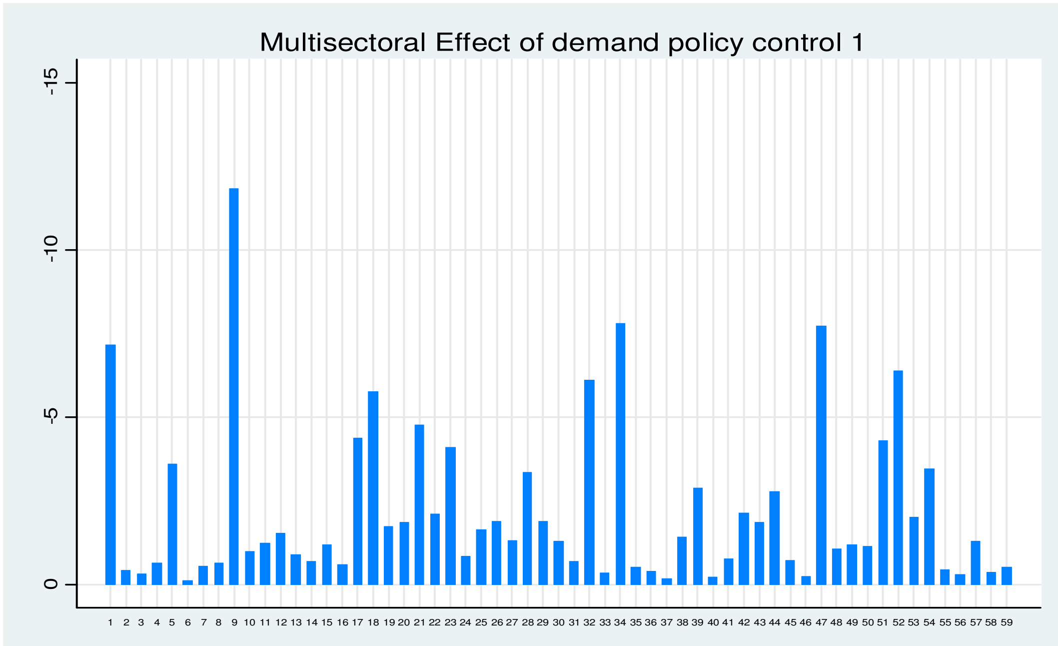
The policy variables (change in final demand) has been based on 59 independent demand sectors and connected with the objective variable (total change in output). By adopting the SVD technique, we have obtained the set of 59 MMs (Si), which is further related with linearly independent set of 59 control variables (matrix V) and target variables (matrix U). The MM with respect to different commodities has been portrayed in appendix B-XI (figure 2.12), which shows that S is moving in descending to ascending (higher to lower) trend, which is consistent with the theory. The s_1 to s_{59} commodities represent the higher to lower MM, respectively. The detail description of commodities and activities for Russian economy has been given in appendix B-I (table 2.7).

The values of MMs are portrayed in appendix B-VII (table 2.17), therefore the value of s_1 (MM1) is most dominating value with (24.73). The higher value of s_1 (24.73) implies that due to shock in final demand vector there would appear (24.73) times change in total output vector. Similarly, the values of MM from $s2$ to $s42$ amplify the effect of the shock, while the MM from $s43$ to $s59$ reduces the effect from final demand vector to output vector.

By analysing the Policy 1, characterized by modulus-multiplier s_1, by a demand-control structure v_1 and by an overall policy effect on the objective, $s_1 \cdot u_1$ has been portrayed in the second column in appendix B-XIII (table 2.18). It can be seen at row 5 wherein the most relevant component is -1.55, which shows that a demand control tends to have the greatest impact on commodity12 the '*Oil and Gas*'. Similarly, policy 1 is also the most convenient in the case of commodity 43 the '*Mining and Quarrying'*. The result has been shown in row 43 that is the most relevant component with -1.88, which shows highest impact with respect to demand control. As the structures like $s_1.u_1$ and $s_{10}.u_{10}$ are weak structures and both structures are individually not convenient for whole economic growth and dependence on natural resources (reduction in the dependency of Dutch disease). Therefore, the current study adopted the combination of both weak and strong structures mentioned in the Column 4 and 8 in appendix B-XIII (table 2.18). The combination structure with α=0.1 and 1-α=0.9 is convenient for getting both objectives, enhancing the production (output change) and reducing the dependency of natural resources.

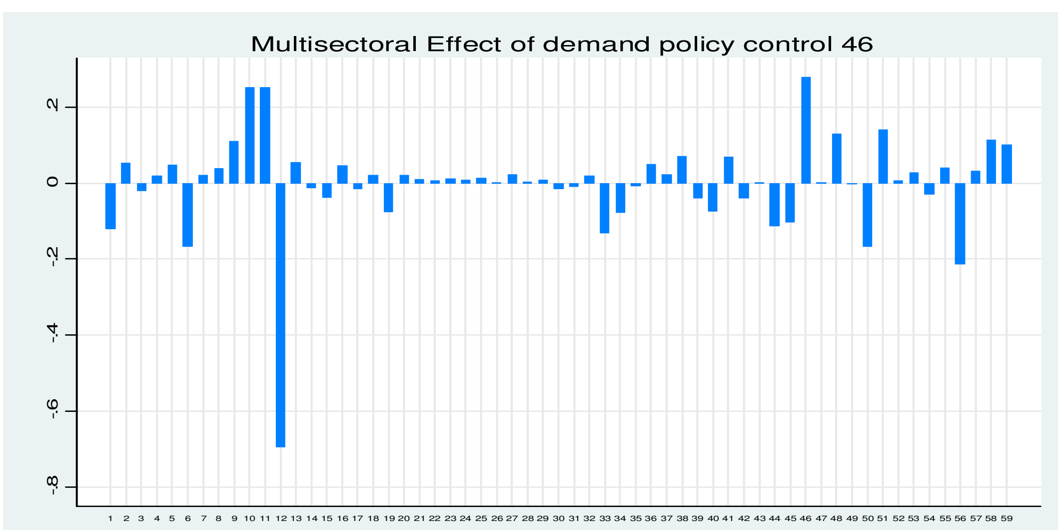
The figure 2.9 represents the convenient policy for (change in output) but it is not convenient for above said dependency on natural resources (Dutch disease).

Figure 2. 9 Policy control 1



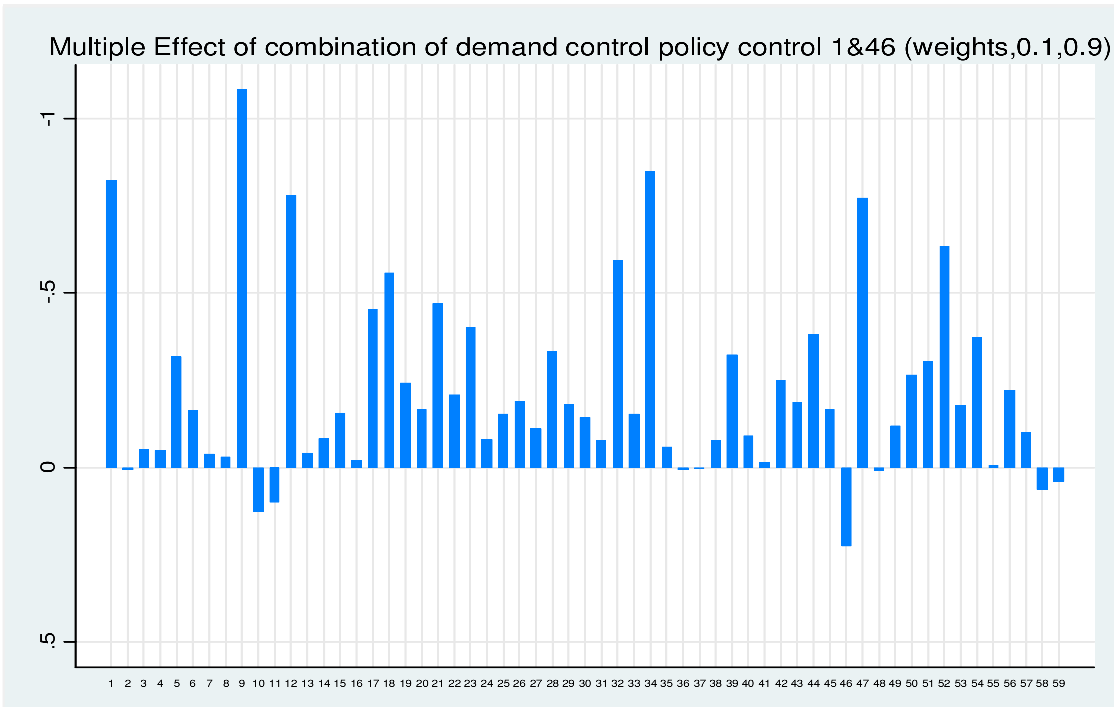
The following figure 2.10 represents the opposite view and is best for reducing the dependency on relying on the natural resources but not convenient for the economic growth. Individually, both policies $s_{1.}u_1$and $s_{10.}u_{10}$ are fulfilling one policy at a time. For achieving both goals of economic growth and 'Dutch disease' dependency reduction, the best policy is combination of policy 1 and 10 because by using the combination of both structures, we can get economic growth as well as 'Dutch disease' reduction.

Figure 2. 10 Policy control 46



The figure 2.11 stands for the different combinations, so the first graph combination by using the α=1 is best for economic growth but without 'Dutch disease' reduction. Similarly, the last graph which has been estimated α=0 is convenient for 'Dutch disease' reduction but without attaining the economic growth. The most convenient graph has been drawn by using α=0.1 and 1-α=0.9 is best for both objectives (economic growth and 'Dutch disease' reduction).

Figure 2. 11 Convenient Policy



The table 2.19 in appendix B-XV depicts the total impact on the ith output (x) of a unitary shock on final demand (f) and the total effect on ith output of a final demand shock according to the structure 1 of the policy. This policy structure is the strongest in terms of magnitude (the detailed matrices are presented in Appendix B-XVI (tables 2.20) and B-XVII (tables 2.21) respectively) and allows the economy to reach the highest performance. All other multipliers produce, comparatively, a lower effect in terms of industrial outputs.

2.7 CONCLUSION

The main findings of current paper have been explored as, first, the identification of Key industries as general and also observe the strength of energy-oriented commodities of Russia by using the dispersion analysis, which is based on MM approach (base year is 2015 for SAM). Second, identify the convenient structure of policy target (output variable) and policy control (final demand), where the dependency on the natural resource ('Dutch Disease') extraction of oil and gas commodities reduction and output increase are compatible.

The policy 1 is also most convenient and dominating policy for both industry 12 and industry 43 and supports the economic growth attainment. As, the results suggested that the most relevant component of industry 4 is -1.55, which shows that a demand control tends to have the greatest impact on industry 12 i.e. the '*Oil and Gas'*. Similarly, in the case of industry 43 the *'Mining and Quarrying'*, the most relevant component is -1.88.

As the structures like s_1u_1 and $s_{10}.u_{10}$ are weak structures and both structures are individually not convenient for whole economic growth and reduction in the dependency of natural resources ('Dutch disease' reduction). The structure s_1u_1 is weak and estimated by using the α=1, which is only best for economic growth but not convenient for 'Dutch disease' reduction. Similarly, the structure $s_{10}.u_{10}$ is also weak and estimated by using α=0 which is only convenient for 'Dutch disease' reduction but without attaining the economic growth for Russian economy.

Usually, policy recommendation for 'Dutch disease' reduction means that there is obviously trade-off between the 'Dutch disease' reduction and the output of different sectors of the economy. So, due to this limitation, it is difficult for economist to propose any policy recommendation for natural resource abundance countries (facing Dutch disease issue), the current study has tried to fulfil this limitation and recommends the one of the appropriate policies for getting both objectives simultaneously. The combination structure with α=0.1 and 1-α=0.9 is convenient for getting both goals simultaneously, enhancing the production (economic growth) and on the other hand reducing the dependency on natural resources ('Dutch disease').

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Appendix B-I

Table 2. 7 Commodities and Activities in Russian Financial Social Accounting Matrix for year 2015

S.NO	*Commodities*	*Activities*
A	**Agriculture, Hunting and Forestry**	
1	Products and services of agriculture and hunting	Agriculture, hunting and rendering of services in these areas
2	Forestry products, logging and related services	Forestry, logging and related service areas
B	**Fishing, Fish farming**	
3	Fish and other fishing products and aquaculture; services related to fishing	Fishing, fish farming and related service activities
C	**Mining**	
4	Black coal, brown coal (lignite); peat	Mining of coal, lignite and peat
5	Oil and natural gas; services related to oil and gas extraction, except prospecting works	Crude oil and natural gas; rendering of services in these areas
6	Uranium and thorium ores	Mining of uranium and thorium ores
7	metal ores	Mining of metal ores
8	Other mining and quarrying products	Other mining and quarrying
D	**Manufacturing**	
9	foods and drinks	Manufacture of food products and beverages
10	tobacco goods	Production of tobacco
11	Textile	Textiles
12	Clothing; fur	Manufacture of wearing apparel; dressing and dyeing of fur
13	Leather and leather products	Manufacture of leather, leather products and footwear
14	Wood and products of wood and cork (except furniture), articles of straw and plaiting materials	Processing of wood and of products of wood and cork, except furniture
15	Pulp, paper and paper products	cellulose, wood pulp, paper, cardboard and their products
16	Printing production and media recorded	Publishing printing and reproduction of recorded media
17	Coke oven products and petroleum products	Coke production; petroleum products
18	Chemical substances, chemical products and chemical fiber, except explosives	Chemical production (excluding production of gunpowder and explosives)
19	Rubber and plastics	Rubber and plastic articles
20	Other non-metallic mineral products	Other non-metallic mineral products
21	metals	metallurgical industry

22	Fabricated metal products, except machinery and equipment	Manufacture of fabricated metal products
23	Machinery and equipment that is not included into other categories (except for arms and ammunition)	Manufacture of machinery and equipment (excluding the production of weapons and ammunition)
24	Office equipment and computers	Manufacture of office machinery and computers
25	Electrical machines and equipment	Manufacture of electrical machinery and apparatus without the production of insulated wires and cables
26	electronic components; instruments for radio, television and communication	Manufacture of electronic components, equipment for radio, television and communication
27	Medical devices; apparatus and instruments for measuring, checking, testing, navigation and control; optical instruments, photographic film; and instruments, watches and clocks	Production of medical products; measuring means, control, monitoring and testing; optical instruments, photographic and film equipment; hours
28	Motor vehicles, trailers and semi-trailers	Manufacture of motor vehicles, trailers and semi-trailers
29	Other vehicles and equipment, other engineering products and petrochemicals	Production of ships, aircraft and spacecraft and other vehicles; Manufacture of other products of mechanical engineering and petrochemistry
30	Furniture; other manufactured goods nec	Production of furniture and other goods, not included in other categories
31	Recycled materials	Processing of secondary raw materials
E	**Production and distribution of electricity, gas and water**	
32	Electricity, gas, steam and hot water	Production, transmission and distribution of electricity, gas, steam and hot water
33	Water is collected and purified, distribution services of water	Collection, purification and distribution of water
F	**Building**	
34	work construction	Building
G	**Wholesale and retail trade; repair of motor vehicles, motorcycles, household goods and personal items**	
35	Trade, maintenance and repair of motor vehicles and motorcycles	Commercial vehicles and motorcycles, their maintenance and repair (without retail motor fuel)
36	Services in wholesale trade, including trade through agents, except of motor vehicles and motorcycles	Wholesale trade and commission trade, except of motor vehicles and motorcycles
37	Retail trade, except of motor vehicles and motorcycles; repair services for household goods and personal items, retail trade services of motor fuel	Retail trade, except of motor vehicles and motorcycles; repair of household goods and personal items; retail sale of automotive fuel
H	**Hotels and restaurants**	
38	Hotel and restaurant services	Activity of hotels and restaurants
I	**Transport and communications**	
39	Services Land transport and transport via pipelines	Land transport activities
40	Water transport services	Water transport
41	Services of air and space transport	Activity of air and space transport
42	Transport auxiliary services and additional; travel agency services	Supporting and auxiliary transport activities

43	Postal and Telecommunications Services	link
J	**Financial activities**	
44	financial intermediation services	financial intermediation
45	Insurance and Private Pensions, except for services of mandatory social insurance	Insurance
46	Support services in the field of financial intermediation	Activities auxiliary to financial intermediation and insurance
K	**Operations with real estate, renting and business activities**	
47	Services related to real estate	Real estate activities
48	Rental services of machinery and equipment (without operator), household goods and personal use items	Renting of machinery and equipment without operator; rental of household goods and personal items
49	Software products and services associated with the use of computers and information technology	Activities related to the usage of computers and information technology
50	Services related to scientific research and experimental development	Research and development
51	Other services related to entrepreneurial activity	Other service activities
L	**Public administration and defense; social insurance**	
52	in public administration services, military security and welfare	Public administration and defense; social insurance
M	**Education**	
53	Education services	Education
N	**Health and social services**	
54	Health services and social services	Health care and social services
O	**Other community, social and personal services**	
55	Services for the collection of waste water and waste, improve sanitation and similar services	Wastewater collection, wastes disposal and similar activities
56	Services social organizations, not included in other categories	Activities of membership organizations
57	Services in organization of leisure, entertainment, culture and sport	Activities, recreation and entertainment, culture and sport
58	personal services other	Personal services
P	**Activities of households**	
59	Services of households as employers	Activities of households as employers

Appendix B-II

Table 2. 8 Block of Intermediate Consumption for Russia 2015 – Million Rubles

ACTIVITIES (columns) / COMMODITIES (rows)

n.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
1	1194034	1717	674	5	12	0	14	109	2143608	62932	10711	1178	7139	27	29	1	20	2769	8728	53	46	11	30	0	15	43	57	1	101	68	0	102	23	492	35	10697	7046	49760	217	649	21	6924	5	0	0	0	1400	85	24	694	1060	43020	5401	31900	248	1341	2636	6967	0
2	1787	27991	2	234	132	0	48	38	565	0	1	6	0	119699	40325	4	0	528	20	453	390	197	43	0	8	6	9	12	414	3941	1	7258	16	5959	2	1101	481	35	379	44	0	203	150	0	0	0	378	55	0	31	128	7187	207	463	25	41	262	213	0
3	90	0	7591	0	0	0	1	0	104769	0	0	0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	3	0	3	2	0	10	1	30	0	388	378	12016	11	8	0	46	0	0	0	0	35	17	0	104	28	570	12	435	1	44	153	0	0
4	3167	9	95	154908	282	15	289	169	2151	0	15	8	3	16	2260	4	63676	2110	13	7566	157442	148	689	0	21	18	15	12	1169	15	9	180107	203	349	17	705	200	106	633	181	30	692	206	0	0	0	608	25	2	26	794	4499	733	3467	209	30	295	195	0
5	140	0	0	356	514964	0	0	206	132	0	0	0	0	0	0	0	3132734	0	17	947	0	0	76	0	0	67	0	0	11	0	0	1327021	0	6525	12	156118	5	0	52046	0	6	397	0	0	0	0	559	0	18	26	6536	0	0	16	3	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2762	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	67	0	0	10260	14	0	0	0	0	0	0	0	0	0	6725	0	3233	418638	0	0	0	14	0	9	0	1043	0	0	21	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0
8	2742	318	86	1146	4192	0	1864	10035	5800	0	55	10	26	207	346	244	773	66992	619	114935	9706	1314	668	0	211	177	63	48	2898	42441	145	911	577	147130	77	1416	231	753	2664	82	0	17870	6	0	0	0	936	254	0	120	1071	212	41	104	3437	44	107	1907	0
9	420504	78	8004	68	167	0	90	46	1300445	9	1106	596	2377	160	713	90	129	9316	88	1075	431	377	278	3	67	32	260	25	673	198	3	714	466	536	179	20933	53792	266549	1039	575	262	8291	33	0	219	0	1458	162	202	1439	4630	105225	23698	127951	107	4542	5488	1300	0
10	6	0	0	0	0	0	13	0	36	21708	0	0	0	0	0	0	0	45	0	1	13	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	46	498	1	0	0	6	1	0	0	0	6	1	0	0	219	448	0	26	0	0	19	3	0
11	2184	175	4872	463	139	3	106	684	8508	686	62071	71516	3856	488	894	422	333	2098	10372	1795	1188	230	1214	0	331	99	952	4968	3236	12948	47	149	14	18220	55	1777	2115	4096	517	306	163	675	1305	145	0	2	825	70	9	835	3842	12145	1227	15591	35	323	1435	2206	0
12	2565	553	34	992	6063	6	657	747	2882	38	93	7448	1078	621	477	170	1465	1093	856	2018	4383	1606	4068	27	878	271	507	1314	6515	855	265	6055	582	11276	779	3114	6590	3943	5973	314	330	3408	812	339	0	4	1250	248	49	1686	2866	36329	1148	13045	641	387	4875	399	0
13	104	11	10	133	58	0	23	22	151	0	34	2453	20144	12	17	39	58	51	29	90	307	198	168	0	17	19	399	14	133	2779	3	109	18	199	10	403	3102	36	96	3	0	115	83	38	0	1	67	12	4	33	189	5898	277	2953	10	97	680	14	0
14	4830	1682	83	936	222	5	193	326	8543	17	61	31	90	73561	8487	324	514	3447	690	13645	3343	3906	1217	2	2051	137	327	871	3531	66082	10	1408	77	204192	302	4317	1571	370	1806	251	0	7554	172	0	8	1	64597	376	28	476	1295	2457	925	1264	195	166	1014	2778	0
15	21966	298	3286	81	470	0	86	500	164718	32198	2044	674	940	12479	156251	84383	326	20487	10101	19559	1295	3674	3204	96	3509	1312	1821	1363	3244	9886	3442	1596	119	9020	764	28083	24485	11968	1884	347	280	3538	1731	4184	1517	115	38338	143	1735	1037	18176	14930	2887	7132	187	1413	2066	199	0
16	402	115	26	39	980	0	63	163	11662	428	131	152	23	176	1078	91807	767	2841	376	307	387	432	769	5	186	105	124	136	347	258	42	730	44	5037	7677	57649	24223	8443	1021	102	365	2203	3249	16371	12318	209	3209	961	6267	2771	30461	44650	11405	10842	56	12884	9877	474	0
17	162643	34009	71346	50273	127295	207	25563	38985	37904	699	1155	653	199	15454	11338	1366	950955	335348	5215	47736	148588	8706	14126	88	5802	1626	1857	3432	27078	4391	4721	139502	5072	311822	16709	126031	91840	5451	530096	39480	219011	148266	13983	7503	4730	92	19723	14659	1422	6977	36375	117959	6456	28001	23906	1667	6940	3260	0
18	244318	635	497	2584	49602	139	6601	1869	97034	13374	48222	2812	4534	40838	54062	27169	146164	637922	445241	89630	76219	35232	37001	493	35441	9239	13022	32958	50304	26816	2619	3870	6519	74107	6591	41872	12031	7746	10039	549	585	10046	449	303	277	98	28487	976	1227	23976	34429	52764	8398	492556	5410	741	11205	10065	0
19	23231	1960	2387	8689	9407	15	3370	4899	122003	5300	2448	778	720	8490	5776	8882	3067	30815	73977	17292	6158	20792	43524	1582	24412	5862	6850	80695	21580	32768	357	10802	2775	426231	5961	35228	62160	9274	18622	211	1289	12504	1648	765	1209	11	98709	1426	1690	3572	11056	5842	2426	9566	2409	522	1261	473	0
20	5939	522	173	998	11920	26	1439	2709	60107	1	139	157	70	2978	664	124	317	9972	12687	221025	59084	13306	15035	390	10502	1594	2229	21296	10751	5884	1262	10791	1091	1099900	3009	5399	4120	4268	6934	1739	69	24486	236	0	29	0	84632	984	124	2585	10454	3472	1815	5217	5453	2152	1529	1287	0
21	2385	699	1004	6071	94118	55	14932	2611	15792	3077	455	49	30	2700	2166	3557	9210	13147	8752	44729	1156449	481566	236245	3094	216058	16786	30997	108149	207161	52094	202741	21975	3265	543937	2443	6016	3727	159	21886	733	5	11793	177	0	0	0	14402	2051	27	20030	10382	2141	648	1055	823	323	242	152	0
22	20035	3534	3319	10165	26645	12	9618	5731	70405	670	768	1295	1065	6807	3841	834	5832	13559	7107	28665	18692	88400	148440	1388	18334	7975	17041	71288	117422	24687	1592	36429	1353	675683	10934	26885	3012	3003	10790	1283	682	17045	1234	1452	1098	21	35539	3622	410	16759	17854	7990	1268	2937	1852	638	827	1190	0
23	116460	12759	10959	57215	93342	122	39125	36821	54534	1579	2961	1990	375	13351	19869	3818	28227	28041	13736	43162	143170	33431	288588	715	19591	12880	23981	46013	196378	6101	2870	39554	7604	198919	16069	46126	41628	5941	58159	5893	8035	35491	5551	95	130	4	53763	6368	5817	32304	22330	16571	4084	9838	12672	603	4142	4144	0
24	206	661	43	192	510	0	81	65	361	6	19	23	11	60	59	3911	117	966	109	521	1061	780	1877	25919	1137	1617	1749	707	3022	47	96	2382	167	10517	1236	17859	18097	1068	1415	36	227	2247	5499	12616	7232	135	3420	546	41876	19393	31284	23937	4637	4047	400	654	2857	185	0
25	5806	805	302	5479	47984	18	3109	1892	1633	1	125	37	17	431	614	155	6360	4931	918	7401	21138	13484	84755	1872	122557	15586	38105	44934	102440	871	1054	74584	1033	229517	14065	17168	13534	1744	45633	2222	6433	28961	15890	4363	238	38	22559	1243	5284	71865	14465	18807	1403	3584	802	333	4982	318	0
26	127	33	6	101	181	0	47	30	99	0	3	61	0	11	19	4739	42	97	140	106	737	115	5551	16506	11374	166032	69305	2318	46654	73	2	562	16	5761	1011	6838	2781	299	5248	110	399	3375	84507	1810	1334	19	432	315	22566	82840	20565	6021	364	915	34	84	27942	10	0
27	1800	81	1314	910	23881	1	933	204	2998	3	347	82	4	457	478	23	3822	5155	629	1801	8088	5569	17322	84	3629	9243	91833	8444	89231	129	388	6713	616	31882	74	7095	2567	80	5554	395	1904	2644	1896	0	0	7	4919	803	618	154076	15174	7601	2777	89973	611	229	3812	222	0
28	9700	6226	132	2071	4205	0	3748	3140	2090	0	128	220	6	1168	964	611	400	329	1730	1887	6226	962	9698	1	1902	545	1275	716668	6586	239	761	2430	735	15157	133804	24114	13642	342	67935	299	37	23476	1339	21	1259	2	2286	4259	247	2157	4397	6453	903	3613	3646	204	695	861	0
29	241	84	3911	4643	2739	59	13385	10436	1259	0	1	0	0	76	19	634	148	1367	575	928	6953	330	1286	0	254	616	4357	370	662691	6	5	41726	25	17216	878	4726	603	13	173866	10463	55149	64205	45	0	0	0	431	6633	0	89688	7832	54444	761	170	142	119	1390	40	0
30	688	364	70	205	775	1	117	411	1731	42	786	1021	458	98	220	857	101	5348	224	387	1251	1341	717	80	250	274	1798	11679	2650	12713	24	1449	124	11665	818	9950	13152	4107	1059	23	25	3671	1286	6039	709	37	9107	915	2372	2003	6442	4114	2801	5061	449	2385	12207	2591	0
31	327	0	1	1	56	0	14	3	122	0	0	0	0	1	18923	4	0	293	3488	14484	375726	23816	2267	0	104	0	1	92	6714	22	56023	86	1	288	3	2396	0	0	116	36	0	5	1	0	0	0	471	0	1	400	583	18	5	29	11	1	88	183	0
32	85881	2776	2133	19576	260296	256	44063	26880	95238	1141	9292	3184	1583	23053	39861	5329	99325	144391	25072	123552	348238	28391	31775	423	16550	7414	11189	24944	67580	6698	2038	2455650	55627	57240	12540	47608	185839	40594	286009	1212	2016	35944	38353	18119	3299	192	273627	14036	5322	38099	20435	164649	103634	149580	13248	3555	35985	7468	0
33	2673	36	56	352	3877	0	307	226	5632	83	225	209	57	439	630	247	2565	4270	557	1474	3946	958	1284	20	490	528	597	1781	3790	131	44	39705	4870	2206	624	1961	5845	2573	2016	147	37	1042	355	0	147	2	9768	87	183	2073	1143	7060	5525	12928	648	223	1684	743	0
34	15459	876	1670	8026	144313	17	5889	9733	14133	1496	792	519	148	1880	2473	1492	25921	16767	3393	9491	37493	4100	6401	95	7286	3834	5480	2569	21198	1024	620	74836	11089	266898	2703	33488	50565	32453	105073	1544	1418	34412	11725	3003	717	29	310746	5695	4957	34285	33595	476118	89862	170729	14960	2821	58774	1317	0
35	1779	848	142	1604	2687	50	392	604	1762	14	69	161	37	449	131	203	1512	795	190	1605	1308	445	1194	5	391	85	175	1413	555	97	411	2022	1557	11216	40427	15760	6780	351	52598	232	458	15401	2608	8188	389	102	5692	3174	701	613	4588	44033	2532	5806	683	449	1753	387	0
36	41665	1212	896	962	71902	2	69	1237	31570	101	108	783	24	812	410	552	29229	8239	253	364	2447	1347	6509	0	311	139	948	230	23414	644	174	1983	3	238	15	285576	138253	46	258	13	371	763	877	0	0	0	516	70	1922	2401	505	705	36	600	41	44	205	19	0
37	37	0	0	0	0	0	0	0	48	0	0	0	0	22	1	1	0	8	6	1	0	0	81	0	0	0	0	7	15	1	1	3	0	1	2	37	3734	12	6	0	0	12	0	0	2	0	2	501	51	5	5	156	42	184	1	1	23	54	0
38	387	135	85	264	6014	19	121	549	3373	71	50	96	23	186	362	453	939	2326	395	518	1244	1181	3063	159	852	454	1662	651	4719	186	85	3311	55	12323	805	10030	7707	3138	6890	164	7304	14964	1432	8252	3977	97	948	85	3800	8314	13802	75358	16378	29265	78	10788	12525	256	0
39	43556	12358	452	57091	416745	61	14430	16858	84923	2030	1594	1093	415	15290	16808	5139	386573	80224	10679	37517	85275	13355	15480	447	5476	2636	2948	12614	11030	3793	2229	22638	917	112720	24514	1571348	241263	7880	296520	1223	2189	400722	11962	1357	706	20	13659	4215	5197	5290	23109	68649	5043	15356	4509	2879	5466	2255	0
40	62	894	11647	1473	6755	0	1746	2089	3736	79	116	289	7	2611	3839	9	9744	2107	80	847	3051	133	402	0	219	114	107	668	4282	1	43	564	9	5506	147	13605	6719	215	698	5106	38	21184	32	0	0	0	46	38	7	882	6198	359	8	6	92	110	0	2	0
41	468	84	734	129	22402	4	834	2056	1452	80	46	143	21	96	216	525	1836	1047	332	468	5508	1515	1961	116	531	386	900	1310	4785	174	61	2345	79	9933	712	19932	17453	1137	7535	309	47195	58398	5788	7948	1635	82	694	198	2273	5257	11352	94375	3321	12409	81	2257	8044	90	0
42	29787	7127	1053	50238	63418	23	24470	20988	52936	606	468	1022	29	12002	15525	2231	305088	59449	2391	36888	72841	10455	16531	407	4765	2144	1505	17483	14509	2712	3902	12899	869	45970	49982	619472	127795	2231	239740	13628	284163	497146	5874	0	0	0	7752	7951	2518	6106	17329	223635	871	6141	1965	3272	5052	65	0
43	3162	248	629	449	5033	5	298	462	3777	213	176	300	59	443	670	2170	1476	1724	600	1203	2323	1146	2221	122	817	582	907	696	2065	683	174	10557	692	7044	3041	28238	34816	2548	31684	533	5034	8326	401022	36850	15901	426	8434	1116	27725	5429	26416	78863	12474	13840	511	3212	29391	1096	0
44	55655	4954	4900	14136	69257	38	13134	7054	96145	3128	4411	4853	1408	12287	12748	6360	116910	33764	14205	25202	61489	23922	28990	2052	16854	6217	9506	27397	40388	10472	9265	85907	5200	139224	22708	157641	176827	42470	87146	2836	17048	86007	19384	267295	35377	6878	56934	8637	22277	26101	65639	88697	3836	16406	2905	10655	19059	3459	0
45	5616	365	432	1449	7789	4	763	709	13129	473	472	376	148	1150	1308	857	16296	4892	2078	2902	9820	2612	3226	184	1639	874	1117	3794	5564	1083	907	14210	428	14251	1712	14270	8879	2327	26986	422	2261	5682	2662	0	116728	0	29053	428	1485	2506	4501	1134	182	823	383	0	1052	271	0
46	25	98	0	2	11	0	3	17	33	1	0	2	0	0	8	0	137	30	3	9	49	21	66	4	6	1	9	2	34	7	0	57	1	55	313	602	7	29	251	11	0	237	48	51876	64667	284	112	5	1081	37	317	617	14	72	2	5	7	0	0
47	11150	931	1338	1217	209909	38	826	2199	44674	1096	3676	7059	1715	10706	4955	13818	20427	18302	14633	15631	12323	27368	23085	2375	11223	5929	8849	16733	11528	17116	3286	60535	5045	86428	77899	342605	934345	129414	484268	4458	7891	125530	102221	154547	39632	2570	592147	6677	58751	15122	158454	78734	25153	56479	5036	13232	53712	30662	0
48	17362	6381	13909	5375	171195	0	4749	6690	22642	794	1710	733	242	6112	2921	3420	23461	13565	6743	17781	7916	12212	10345	125	4036	1290	2822	3850	5703	2791	4408	40395	2494	171091	10935	88495	36105	6216	295226	28153	82917	96522	14519	0	13	0	13467	29232	6162	1692	39902	1098	1824	10120	9260	147	14965	1884	0
49	2370	269	271	1192	19548	0	807	217	11489	1956	192	379	48	426	1633	2468	25361	3893	1298	1991	7439	2019	4863	2990	1427	5478	2802	3127	5091	625	323	20030	955	10420	9187	63706	41200	2990	9919	400	4156	17915	43133	121728	12093	1427	31930	802	222369	32800	56094	183168	21730	30410	1074	3833	10900	1099	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78730	0	371	0	0	0	0	0	0	0
51	15356	2559	1845	23873	161290	137	13518	20778	239427	5882	3051	12333	713	6337	12714	16479	140341	77701	22337	30569	86124	24485	36554	2480	14113	13443	25754	33585	115112	11528	5241	89827	15147	196337	112570	837616	410000	82410	94363	1737	15128	88074	94054	191753	55101	2277	206821	12960	46454	249651	514096	247172	41903	60474	5290	8614	103909	8752	0
52	1277	439	518	1121	4529	2	470	493	4177	121	104	492	73	711	915	1275	14870	1971	1081	1984	3191	1085	2539	136	853	360	1151	2317	6697	566	247	3483	250	17333	2680	43442	10524	1987	8584	399	5426	5490	9722	13669	62	182	7197	484	3208	3406	25307	15292	796	3222	471	216	2784	166	0
53	444	38	145	230	2748	4	174	267	909	95	37	59	4	89	492	141	749	855	168	390	1249	401	1007	31	275	214	374	604	1886	36	50	2738	166	2428	369	3652	2819	503	7736	124	1656	2447	1005	3351	454	41	674	168	1357	2251	5768	19890	34937	10584	147	2379	1469	137	0
54	13990	40	966	455	1881	1	243	336	1773	64	39	22	9	93	158	97	546	597	154	261	1648	305	641	9	181	141	211	550	1013	35	33	2112	243	1719	92	1703	2633	1007	6929	65	210	1971	675	1531	179	18	875	66	260	2604	2310	39493	4758	40755	176	2915	1567	83	0
55	1749	39	82	580	4668	19	540	624	3283	122	181	71	76	376	1065	167	5468	2955	453	1022	4442	787	1235	10	411	226	750	1624	2782	126	150	7473	8574	5071	502	4763	6564	1554	2261	364	152	4884	2798	402	405	8	63439	370	203	3848	4097	98871	9243	20347	10870	350	7472	416	0
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	33	3	18	47	274	0	74	857	55	0	24	1	1	15	193	1498	1573	122	32	92	156	35	89	10	43	37	35	276	133	1	0	349	42	165	37	1919	412	367	161	4	31	436	61	10295	2021	112	461	13	2585	273	204371	28515	4850	3220	9	18274	104369	705	0
58	40	8	0	9	167	0	13	16	335	0	0	4	0	20	20	87	46	42	3	21	200	45	91	1	21	1	43	4	720	1	1	21	58	119	166	112	1261	3151	132	16	51	111	1	0	0	0	210	119	4	149	1076	2549	1102	7711	123	897	1875	270	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix B-III

Table 2. 9 Block of Output for Goods and Services for Russia 2015 – Million Rubles

COMMODITIES

ACTIVITIES

n.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	5199991	389	108	0	0	0	0	23	491247	0	56	369	86	156	0	0	0	44	0	192
2	7	238425	0	0	0	0	124	0	15	0	0	0	0	10199	0	0	0	0	0	4
3	316	2	229154	0	0	0	0	4	123728	0	0	0	0	0	0	0	0	2	0	0
4	0	2	0	771964	0	0	31	38	0	0	6	14	0	0	0	1	0	2	2	0
5	0	1	0	0	8161699	0	0	9107	0	0	0	0	0	0	0	4	623999	5567	9	186
6	0	0	0	0	0	2752	1	0	0	0	0	0	0	0	0	0	0	0	0	0
7	39	183	0	0	0	0	447664	27435	29	0	0	0	0	334	0	10	0	99	0	34
8	313	0	0	0	0	0	2200	552040	83	0	0	0	0	10	0	99	0	47233	17	6213
9	13901	0	3467	0	0	0	0	0	6182929	0	143	54	3	6	1602	78	0	4138	1015	111
10	0	0	0	0	0	0	0	0	0	266374	1	0	0	0	0	0	0	0	0	0
11	231	0	0	0	0	0	0	0	1	0	207565	1630	79	3	2	9	0	727	785	63
12	1	0	0	0	0	0	0	0	0	0	608	195653	2568	0	1	0	0	703	66	0
13	0	0	0	0	0	0	0	0	33	0	62	38	71798	0	0	51	0	122	30	0
14	2	9046	0	0	0	0	0	40	0	0	0	0	0	569009	0	0	0	502	13	41
15	3	6859	116	0	0	0	0	0	349	0	28	2	0	2107	637213	206	0	7399	1641	151
16	0	0	0	0	0	0	0	0	0	0	0	0	0	43	5890	447435	0	0	1332	0
17	0	0	0	1	870185	0	0	0	29	0	0	0	0	0	0	8	5899146	217523	2633	462
18	130	92	68	0	31	0	0	2604	30593	0	1200	75	0	4	7331	21	10996	2510574	7827	2771
19	19	0	77	0	188	0	0	8	0	0	704	19	168	145	885	324	0	1893	869833	815
20	6	0	1	0	71	0	82	8383	159	0	2817	31	0	858	963	0	151	2897	2871	1343003
21	1	4	0	70	6	0	2130	3643	3	0	1	0	0	80	0	19	9668	49288	452	3170
22	45	0	0	0	606	0	0	157	1976	0	107	23	0	482	988	157	0	915	1526	5325
23	30	1	1	12	4795	0	0	0	4	0	8	48	0	350	0	0	0	155	791	412
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	3	0	0	0	0	15	4	1	0	55	2124	694
26	8	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	50	61	338
27	9	0	0	0	0	0	0	0	451	0	0	16	32	150	0	10	0	809	206	44
28	1	0	0	0	0	0	0	62	0	0	126	0	0	2	50	4	0	224	2001	93
29	86	0	1	1238	415	0	0	57	124	0	176	0	129	107	8	12	2	10386	681	231
30	0	113	0	0	0	0	0	0	0	0	603	2	0	2535	3	0	0	424	225	238
31	0	0	0	0	0	0	0	131	0	0	0	0	0	0	0	0	0	12	14	22
32	84	31	3	0	170	0	0	68	100	0	6	5	0	67	1	37	374	3269	55	112
33	22	5	1	0	0	0	0	0	11	0	0	1	0	1	0	0	0	168	0	8
34	401	462	0	109	5604	0	2605	2629	877	0	0	3	0	1198	6	5	17	354	1660	28508
35	1	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	712	2578	83
36	2362	309	87	13	13550	0	0	81	49537	120	1303	1282	38	409	9547	1914	496793	52692	8028	9004
37	50	4	0	0	0	0	0	9	83536	0	538	994	0	11	0	70	4	987	316	160
38	0	0	5	0	123	0	0	2	2218	0	3	21	0	0	0	4	0	0	0	0
39	178	32	2	0	3183	0	0	569	296	0	0	0	0	2	0	169	2303	2	8	86
40	0	30	0	190	0	0	0	2080	0	0	0	1	0	56	0	1	0	18	1	0
41	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0
42	136	64	0	119	0	0	0	2826	2369	0	0	0	4	41	0	90	305	21	157	2475
43	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	107	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	351	12	156	27	16	0	0	2	708	0	308	336	33	246	52	153	0	97	243	2004
48	0	0	0	0	120	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1085
49	0	0	0	0	41	0	0	0	0	0	0	0	0	0	0	211	0	0	0	0
50	73	2	0	0	7	0	0	0	44	0	162	0	0	25	0	335	2	3766	229	2281
51	188	193	0	4	17133	0	5258	398	1841	0	684	62	0	34	0	2066	0	684	154	158
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	19	13	0	0	0	0	0	0	0	0	17	9	0	0	0	129	0	0	0	0
54	15	0	0	0	0	0	0	0	406	0	0	0	0	0	0	6	0	147	0	0
55	344	12	0	0	0	0	0	50	46	0	0	2	0	50	0	1	0	0	0	233
56	338	0	5	0	0	0	0	0	447	0	1	3	2	55	0	21	0	2	0	0
57	21	0	0	0	0	0	0	0	5	0	0	0	0	0	0	211	0	0	0	0
58	28	0	0	0	0	0	0	0	0	0	4	26	3	91	0	0	0	0	0	19
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

n.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	6	59	268	0	4	0	0	0	0	6	0	1372	466	8804	65	5979	2892	2830	2839	16
2	0	0	1	0	0	0	0	0	0	2	0	44	4	524	31	1817	44	55	147	67
3	0	0	1	0	0	0	0	0	129	0	0	155	1	72	0	3236	63	127	51	5526
4	0	42	1033	0	6	0	0	0	55	0	0	812	22	10846	286	8401	2	273	4149	0
5	58	1815	6316	0	109	0	401	0	0	0	0	6300	126	57004	23	25535	588	3271	18702	26
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
7	48352	34	18	0	80	0	0	0	0	159	328	2414	98	8667	58	811	113	740	1000	33
8	0	23	30	0	0	0	7	0	15	7691	0	1774	183	10292	1	5933	48	418	1247	152
9	0	27	350	0	7	1	0	0	0	57	620	1823	45	2153	133	108901	6460	1907	3663	494
10	0	0	0	0	0	0	0	0	0	0	0	105	0	0	0	3166	0	0	6	0
11	16	24	54	0	0	0	0	51	24	263	80	382	13	8421	0	1873	133	63	38	0
12	3	11	11	0	1	0	165	0	0	2	0	14	1	3	0	11814	291	68	8	0
13	0	0	2	0	7	0	12	0	0	0	0	49	4	7	0	1244	156	54	2	0
14	0	277	11	0	1	0	0	0	0	3216	26	737	20	952	2	2955	247	214	341	0
15	13	31	60	0	0	2	2	0	10	33	266	5740	255	232	2	12406	23	210	1151	0
16	0	563	0	0	0	0	0	0	0	2876	1	3	0	163	0	4232	139	81	9	0
17	0	47	112	0	0	0	0	0	101	0	0	39357	679	422	0	105653	145	742	11948	0
18	2704	601	1055	0	479	0	1269	251	1993	71	227	6697	2003	5110	15	68454	867	775	621	6
19	154	1558	174	17	240	103	1	366	54	4278	75	1189	179	1801	3985	13721	41	166	765	0
20	1433	3047	293	0	117	2	0	0	4	694	801	2742	107	14907	15	12950	191	1089	4441	3
21	4879203	43927	3169	0	7343	0	11	50	6480	15295	3632	17664	1054	6196	4	34314	526	1899	4366	2442
22	13453	1116764	18657	0	924	380	771	3709	24384	1049	226	2658	8	4390	11	12491	75	259	324	0
23	4312	22186	1524679	78	27661	1062	4279	2413	13512	985	93	2910	249	13129	1384	41306	147	807	970	0
24	0	28	1194	82477	1793	736	629	0	284	52	0	142	0	114	0	4741	10	21	0	0
25	143	6792	3941	126	742355	2595	3676	301	4759	25	1134	3608	33	3495	192	10554	116	327	86	0
26	57	1307	6357	1493	9486	433361	11879	382	87	107	0	1097	24	424	5	1420	24	361	28	0
27	134	1634	4185	1888	5957	4009	664372	533	4048	524	41	1170	31	3308	18	6188	856	851	61	6
28	6382	4691	4542	169	2779	13	0	1437048	2056	185	1173	648	91	397	36492	4120	127	359	444	0
29	4423	21050	27706	0	2035	167	5690	3754	2815206	2557	674	18186	1084	9116	10	20412	117	4663	533	99
30	185	169	696	0	1530	0	469	24	1417	513929	2	70	0	153	0	2733	590	56	185	0
31	3334	0	106	0	0	0	0	73	352	0	390548	18	250	645	2	6993	1	8	1013	0
32	6	1544	13076	6	7319	6	1808	0	410	0	103	6732859	37159	41938	7	32024	1339	838	4220	21
33	0	0	621	0	513	0	602	0	0	0	0	4433	200425	4688	0	69	4	106	153	0
34	236	8387	16148	0	898	6358	342	0	955	46	752	3107	270	9702600	301	64321	1355	2180	12678	2188
35	0	827	95	0	0	0	0	4000	0	0	0	264	32	972	1286056	4263	26	67	176	0
36	1618	8432	29795	3076	23870	9125	7672	482	288	3189	4153	580	10	21145	7248	9859151	41111	1293	255535	846
37	22	0	73	13	13	1182	77	0	0	430	0	151	3	2149	2052	106077	6411491	29471	1074	1
38	0	4	3	0	4	0	0	0	0	1	0	272	6	296	14	2255	2292	1409955	1006	0
39	0	4315	5404	0	291	42	177	16	17018	41	19	17699	138	15089	2248	14321	1139	5724	6034331	157
40	0	0	173	0	0	0	1	0	681	0	0	17	0	723	0	3841	115	219	2124	199910
41	0	0	0	0	0	0	0	0	178	0	0	0	0	20	0	2075	0	481	36	0
42	43	40	554	0	1	0	41	0	1825	3	1000	2144	143	20537	542	26296	790	2945	123477	8652
43	0	0	0	0	162	3888	115	0	0	0	0	13	0	4803	10	1310	14976	737	1	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	251	311	0	272	15	10	700	30	1034	1	21914	3400	6996	774	2414	7324	5371	2121	84
48	0	179	3807	0	0	0	0	0	12	0	0	92	4	498	20	1721	3	128	4840	12
49	0	0	192	124	952	2	1563	0	0	0	0	47	0	8572	208	16526	218	13	0	0
50	341	4622	16499	6951	6623	42828	57617	136	122046	319	30	3327	109	2734	1	8168	396	2603	92	8
51	785	2130	207	0	921	2097	2474	0	2205	491	18	2767	262	37946	248	39230	5288	4550	506	45
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	0	57	3	0	3	0	0	0	0	11	0	12	0	46	8	10	16	1238	4	0
54	0	0	0	0	0	0	11	0	0	0	0	225	28	86	1	316	425	1470	26	0
55	0	1	47	0	3	0	0	0	224	26	81	1820	10236	2042	30	111	44	283	558	5
56	0	8	280	0	94	1	0	0	0	5	1	10	1	661	22	690	285	477	24	0
57	0	0	27	0	6	0	0	0	0	0	0	23	1	35	51	131	750	5834	17	0
58	0	12	1	0	0	0	0	0	0	111	0	38	26	91	2	47	449	1401	39	3
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

n.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
1	0	1804	301	82	0	0	6222	2366	0	14	768	0	3	94	583	0	48	909	0
2	0	560	3	0	0	0	86	518	0	0	382	0	0	2	2	0	9	48	0
3	0	282	8	0	0	0	207	1410	52	0	32	0	24	0	0	0	0	0	0
4	0	1393	24	0	0	0	1454	3566	3	0	2184	0	30	88	199	0	2	35	0
5	231	3260	161	0	0	0	14284	5921	12	1058	26843	0	49	5045	143	0	175	316	0
6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
7	0	742	28	0	0	0	812	2828	16	0	341	0	5	184	25	0	13	47	0
8	0	4788	111	0	0	0	2394	781	14	44	1639	0	29	598	142	0	61	108	0
9	0	7421	2	372	0	0	7727	6403	0	3	7858	0	4	183	47	0	23	124	0
10	0	187	0	0	0	0	412	0	0	0	103	0	0	0	0	0	0	0	0
11	0	8	1	0	0	0	1067	10	0	0	315	0	0	2	37	0	0	18	0
12	0	22	0	0	0	0	868	820	0	26	68	0	0	0	2	0	0	29	0
13	0	1	0	0	0	0	1359	4	0	0	194	0	0	0	13	0	15	2	0
14	0	614	1	2	0	0	1463	1390	17	0	279	0	0	230	40	0	1	239	0
15	0	1070	2	0	0	0	1523	712	12	0	130	0	0	240	210	0	31	21	0
16	0	170	772	0	0	0	2039	10	42	394	4199	0	4	208	0	0	399	8	0
17	0	6946	64	0	0	0	6048	11068	2268	0	5277	0	2	586	920	0	66	30	0
18	0	2049	280	20	0	0	4047	2710	43	949	5770	0	8	2388	1042	0	80	127	0
19	0	329	2	0	0	0	2708	204	0	52	159	0	0	6	29	0	0	2	0
20	0	1926	4	4	0	0	3706	1179	10	245	1703	0	6	163	75	0	11	168	0
21	0	2480	64	2	0	0	7963	2299	323	2656	3075	0	11	955	378	0	145	97	0
22	0	618	85	0	0	0	2636	122	6	3799	1133	0	7	177	63	0	74	25	0
23	0	9361	62	0	0	0	5635	4747	415	7770	3140	0	4	237	106	0	186	127	0
24	0	0	0	0	0	0	117	0	1619	474	0	0	0	284	0	0	0	0	0
25	0	99	430	0	0	0	4358	184	1073	1914	2470	0	1	123	17	0	56	27	0
26	0	7	117	0	0	0	3838	247	631	15613	2268	0	1	124	3	0	20	7	0
27	22	66	141	0	0	0	5659	143	1140	17220	2017	0	71	289	21	0	197	128	0
28	0	340	42	0	0	0	4515	682	66	424	3710	0	202	37	56	0	70	70	0
29	20268	17987	136	60	0	0	6360	963	533	73249	8968	0	190	3700	1747	0	574	385	0
30	0	85	0	0	0	0	1809	4	801	0	415	0	0	14	1	0	0	27	0
31	0	277	0	0	0	0	466	522	0	46	3184	0	0	0	100	0	0	0	0
32	2	1708	574	29	0	0	23972	2635	1162	225	21425	0	294	576	20689	0	65	1788	0
33	0	143	0	49	0	0	940	58	0	0	1456	0	34	358	96017	0	2	3073	0
34	0	27536	69	402	0	0	36315	5379	949	151	22617	0	48	793	4163	0	147	234	0
35	0	339	1	34	0	209	2848	1636	253	8	3124	0	3	2	30	0	1	9	0
36	0	36438	3636	8101	0	0	803255	12569	14818	806	106668	0	34	2178	98	0	368	482	0
37	0	50933	208	2	0	0	45612	460	773	30	228365	0	50	604	10	0	2854	2706	0
38	1	148	14	0	0	0	7967	213	4	23	6112	0	83	918	108	0	1708	2512	0
39	36	122219	787	0	0	4	14690	17076	304	96	11226	0	242	5771	1481	0	971	665	0
40	0	11547	4	0	0	0	1025	1085	0	0	6134	0	19	36	0	0	0	51	0
41	991027	38591	7	0	0	0	566	3207	58	0	4	0	33	323	0	0	4	1	0
42	576	3017938	373	116	0	1	12083	107040	130	0	7463	0	30	350	729	0	18	1400	0
43	0	20	1928101	8590	0	0	2040	1413	15812	21	3209	0	0	203	0	0	4906	2	0
44	0	0	0	3165814	0	50950	8556	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	659738	11514	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	48739	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	6337	113	1579	0	0	9612611	1808	387	1187	24364	0	51	2064	4778	0	1336	1828	0
48	0	2831	0	41	0	0	1124	1005138	0	263	2185	0	0	78	30	0	66	191	0
49	0	258	5102	5	0	0	1211	246	1099960	66674	7375	0	54	0	0	0	0	0	0
50	0	10376	1126	0	0	0	57676	15881	67196	1222512	434471	0	85130	9251	94	0	210	49	0
51	1	3495	102	326	0	583	28894	1608	2899	7722	4325841	0	279	479	1645	0	1208	240	0
52	0	0	0	0	0	0	0	0	0	0	41474	8423329	0	0	0	0	0	0	0
53	18	45	0	4	0	0	1297	14	74	687	272	0	2377503	130	1	0	291	29	0
54	0	55	0	0	0	0	745	29	5	9	306	0	19	4325647	104	0	210	231	0
55	0	727	2	2	0	0	1150	86	61	2	277	0	0	60	250772	0	20	961	0
56	8	179	0	7	0	1	2212	5	17	59	8562	0	1283	373	11	212496	1005	268	0
57	4	45	109	0	0	0	1202	132	393	73	13976	0	95	81	60	0	1402864	1504	0
58	0	142	0	0	0	0	519	31	2	114	268	0	2	9	124	0	412	301523	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	491851

Appendix B-IV

Table 2. 10 Block of Generation of income for Russia 2015 – Million Rubles

ACTIVITIES

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Compensation of Employees	584839	45002	61480	126792	698905	779	146337	108786	522165	10683	36572	50492	13850	88490	63234	95505	169682	253279	103689	227010
Mixed Income	2599734	69261	134959	176206	5519157	540	129276	288448	861762	96272	25961	35611	11236	104695	163613	75913	1399112	735589	87110	181753
Other Taxes	-51524	819	3993	5090	83229	75	4435	4690	21636	985	744	291	167	2771	3667	401	27723	12326	3062	8348

	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Compensation of Employees	386889	224086	406691	15319	146763	101783	195671	157519	637577	82032	34689	987519	112408	1846278	228509	1878277	1552453	274894	1066906	52408
Mixed Income	1320920	95733	175005	14645	81052	82659	141901	77086	510980	79754	60536	1019062	47457	2861123	478007	5086073	2529927	387915	2068569	48358
Other Taxes	21916	3518	369	205	2664	2102	2293	-36148	6360	873	717	74933	7188	21454	3942	78798	25678	5813	86462	-120

	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
Compensation of Employees	147388	785695	415240	1046815	162504	33188	640371	114975	426819	654991	1381992	3920729	1669057	2507316	84016	104243	576300	67348	491851
Mixed Income	108034	572820	644560	1108801	116764	-750	6876264	763760	267653	450380	1545007	1866439	191402	245971	47791	1517	282651	133934	0
Other Taxes	-1261	23611	18851	113493	6170	757	71820	1397	2208	15124	24019	32368	44736	28012	2224	1061	-22373	962	0

Appendix B-V

Table 2. 11 Block of the Gross Domestic Products by Expenditure Approach – Million Rubles

		Final Consumption for Government	Final Consumption for Households+NPISHs	Gross Fixed Capital Formation for Firms (FC+NFCs)	Gross Fixed Capital Formation for Government	Gross Fixed Capital Formation for Households+NPISHs	Change in Inventories (Change in Stocks)	Exports	Imports
COMMODITIES	1	39549	2779996	831	272	291	150685	415040	787558
	2	12	31126	1192	391	418	31597	83778	3407
	3	12267	46739	-234	-77	-82	461	88038	14810
	4	5	15397	0	0	0	2433	590590	31974
	5	0	0	323475	106050	113375	11740	7987792	336788
	6	0	0	0	0	0	-6	0	1
	7	0	0	0	0	0	12344	118061	71784
	8	0	13073	0	0	0	45987	271430	45164
	9	1307	11259688	0	0	0	106532	574972	1362173
	10	0	1095106	0	0	0	30699	49286	15764
	11	0	617647	2041	669	716	5269	35077	318485
	12	404	1631681	0	0	0	7119	33953	497572
	13	219	845103	0	0	0	-1768	34297	321220
	14	0	92425	87	29	30	8484	307445	62101
	15	0	204824	0	0	0	10728	197837	212893
	16	10563	194175	5696	1867	1996	671	37302	38614
	17	0	1330905	0	0	0	22805	4300720	216427
	18	107516	1936401	0	0	0	99337	1296629	1759374
	19	0	269289	0	0	0	15970	130580	449276
	20	0	172343	0	0	0	24704	88952	185523
	21	0	7955	223585	73301	78364	78753	2085398	456284
	22	0	240254	45157	14805	15827	30957	126160	492427
	23	212	727883	939757	308095	329377	68449	242391	1974206
	24	0	284957	124154	40703	43515	9190	105917	577181
	25	0	84362	185031	60661	64851	29728	115558	563326
	26	58	490034	271620	89049	95201	68264	74286	754227
	27	24531	191235	310181	101691	108715	39439	101047	412946
	28	726	1448221	473594	155266	165990	54055	304193	1154955
	29	0	48893	682179	223649	239097	185141	1286364	626269
	30	0	1032454	169399	55536	59373	2805	124849	360302
	31	0	0	0	0	0	5812	0	0
	32	198221	1191174	0	0	0	0	53854	32855
	33	7652	130617	0	0	0	0	308	513
	34	0	23931	4755770	1559159	1666854	46351	245841	363538
	35	0	324231	0	0	0	0	1445	2929
	36	0	0					675	5559
	37	0	79899					140	139
	38	16206	1342440					12434	7533
	39	141755	800575					278751	40394
	40	14081	11112					80022	53460
	41	16501	485757					445090	276087
	42	0	202802					390818	176317
	43	47929	1327292					102418	179669
	44	0	1046164					74417	148599
	45	19558	346736					46343	97565
	46	0	0					3166	12450
	47	226190	5816077	355350	116500	124547	0	34309	73107
	48	0	11849	0	0	0	0	22804	187757
	49	13829	99936	79622	26104	27907	5633	166619	237922
	50	746	0	755620	247727	264837	69570	20010	11000
	51	78770	166413	345544	113285	121110	15715	639437	991211
	52	8116769	65008				0	0	0
	53	1939884	427594				0	11683	36103
	54	3172656	1054280				0	1138	5140
	55	2565	101856				1074	7224	539
	56	0	212343				0	153	0
	57	555091	451093	64960	21297	22768	2535	15591	98276
	58	8268	308952	0	0	0	0	3502	1211
	59	0	491851	0	0	0	0	0	0

Appendix B-VI

Table 2. 12 Block of the Final Consumption for Russia by Institutional Sectors – Million Rubles

Commodities	Final Consumption for Government	Commodities	Final Consumption for Government	Commodities	Final Consumption for Households+NPISHs	Commodities	Final Consumption for Households+NPISHs
1	39549	31	0	1	2779996	31	0
2	12	32	198221	2	31126	32	1191174
3	12267	33	7652	3	46739	33	130617
4	5	34	0	4	15397	34	23931
5	0	35	0	5	0	35	324231
6	0	36	0	6	0	36	0
7	0	37	0	7	0	37	79899
8	0	38	16206	8	13073	38	1342440
9	1307	39	141755	9	11259688	39	800575
10	0	40	14081	10	1095106	40	11112
11	0	41	16501	11	617647	41	485757
12	404	42	0	12	1631681	42	202802
13	219	43	47929	13	845103	43	1327292
14	0	44	0	14	92425	44	1046164
15	0	45	19558	15	204824	45	346736
16	10563	46	0	16	194175	46	0
17	0	47	226190	17	1330905	47	5816077
18	107516	48	0	18	1936401	48	11849
19	0	49	13829	19	269289	49	99936
20	0	50	746	20	172343	50	0
21	0	51	78770	21	7955	51	166413
22	0	52	8116769	22	240254	52	65008
23	212	53	1939884	23	727883	53	427594
24	0	54	3172656	24	284957	54	1054280
25	0	55	2565	25	84362	55	101856
26	58	56	0	26	490034	56	212343
27	24531	57	555091	27	191235	57	451093
28	726	58	8268	28	1448221	58	308952
29	0	59	0	29	48893	59	491851
30	0	-		30	1032454	-	

Appendix B-VII

Table 2. 13 Block of Gross Fixed Capital Formation for Russia 2015- Million Rubles

Commodities	Gross Fixed Capital Formation for Firms (FC+NFCs)	Commodities	Gross Fixed Capital Formation for Firms (FC+NFCs)	Commodities	Gross Fixed Capital Formation for Government	Commodities	Gross Fixed Capital Formation for Government	Commodities	Gross Fixed Capital Formation for Households+NPISHs	Commodities	Gross Fixed Capital Formation for Households+NPISHs
1	831	31	0	1	272	31	0	1	291	31	0
2	1192	32	0	2	391	32	0	2	418	32	0
3	-234	33	0	3	-77	33	0	3	-82	33	0
4	0	34	4755770	4	0	34	1559159	4	0	34	1666854
5	323475	35	0	5	106050	35	0	5	113375	35	0
6	0	36	0	6	0	36	0	6	0	36	0
7	0	37	0	7	0	37	0	7	0	37	0
8	0	38	0	8	0	38	0	8	0	38	0
9	0	39	0	9	0	39	0	9	0	39	0
10	0	40	0	10	0	40	0	10	0	40	0
11	2041	41	0	11	669	41	0	11	716	41	0
12	0	42	0	12	0	42	0	12	0	42	0
13	0	43	0	13	0	43	0	13	0	43	0
14	87	44	0	14	29	44	0	14	30	44	0
15	0	45	0	15	0	45	0	15	0	45	0
16	5696	46	0	16	1867	46	0	16	1996	46	0
17	0	47	355350	17	0	47	116500	17	0	47	124547
18	0	48	0	18	0	48	0	18	0	48	0
19	0	49	79622	19	0	49	26104	19	0	49	27907
20	0	50	755620	20	0	50	247727	20	0	50	264837
21	223585	51	345544	21	73301	51	113285	21	78364	51	121110
22	45157	52	0	22	14805	52	0	22	15827	52	0
23	939757	53	0	23	308095	53	0	23	329377	53	0
24	124154	54	0	24	40703	54	0	24	43515	54	0
25	185031	55	0	25	60661	55	0	25	64851	55	0
26	271620	56	0	26	89049	56	0	26	95201	56	0
27	310181	57	64960	27	101691	57	21297	27	108715	57	22768
28	473594	58	0	28	155266	58	0	28	165990	58	0
29	682179	59	0	29	223649	59	0	29	239097	59	0
30	169399	-	-	30	55536	-	-	30	59373	-	-

Appendix B-VIII

Table 2. 14 Block of Change in Inventories for Russia 2015 – Million Rubles

Commodities	Change in Inventories (Change in Stocks)	Commodities	Change in Inventories (Change in Stocks)
1	150685	31	5812
2	31597	32	0
3	461	33	0
4	2433	34	46351
5	11740	35	0
6	-6	36	0
7	12344	37	0
8	45987	38	0
9	106532	39	0
10	30699	40	0
11	5269	41	0
12	7119	42	0
13	-1768	43	0
14	8484	44	0
15	10728	45	0
16	671	46	0
17	22805	47	0
18	99337	48	0
19	15970	49	5633
20	24704	50	69570
21	78753	51	15715
22	30957	52	0
23	68449	53	0
24	9190	54	0
25	29728	55	1074
26	68264	56	0
27	39439	57	2535
28	54055	58	0
29	185141	59	0
30	2805	-	-

Appendix B-IX

Table 2. 15 Block of the Rest of the world for Russia – Exports and Imports 2015- Million Rubles

Commodities	Rest of the world		Commodities	Rest of the world	
	Exports	Imports		Exports	Imports
1	415040	787558	31	0	0
2	83778	3407	32	53854	32855
3	88038	14810	33	308	513
4	590590	31974	34	245841	363538
5	7987792	336788	35	1445	2929
6	0	1	36	675	5559
7	118061	71784	37	140	139
8	271430	45164	38	12434	7533
9	574972	1362173	39	278751	40394
10	49286	15764	40	80022	53460
11	35077	318485	41	445090	276087
12	33953	497572	42	390818	176317
13	34297	321220	43	102418	179669
14	307445	62101	44	74417	148599
15	197837	212893	45	46343	97565
16	37302	38614	46	3166	12450
17	4300720	216427	47	34309	73107
18	1296629	1759374	48	22804	187757
19	130580	449276	49	166619	237922
20	88952	185523	50	20010	11000
21	2085398	456284	51	639437	991211
22	126160	492427	52	0	0
23	242391	1974206	53	11683	36103
24	105917	577181	54	1138	5140
25	115558	563326	55	7224	539
26	74286	754227	56	153	0
27	101047	412946	57	15591	98276
28	304193	1154955	58	3502	1211
29	1286364	626269	59	0	0
30	124849	360302	-	-	-

Appendix B-X

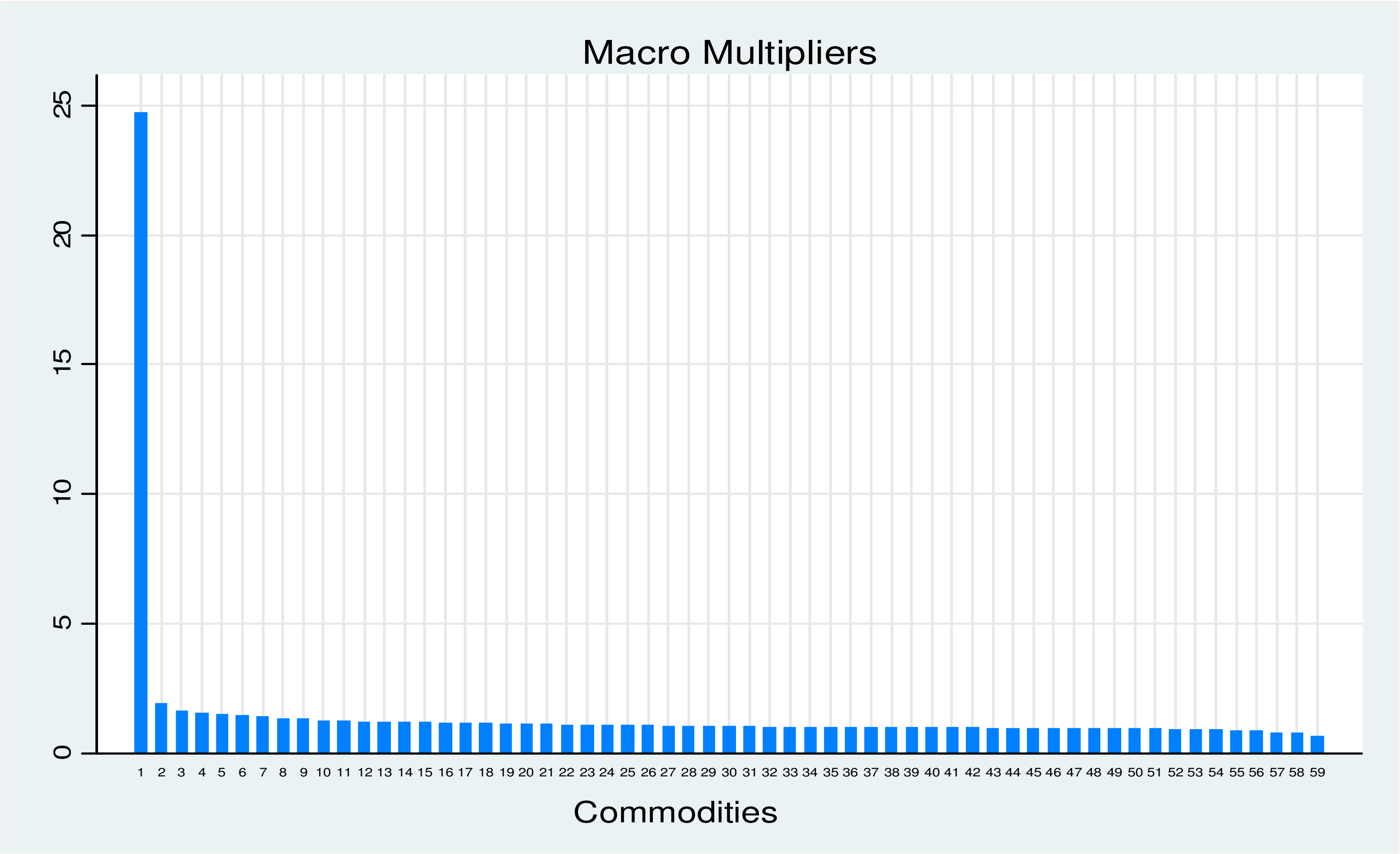
Table 2. 16 Linkages analysis for the Russian Commodities with respect to Backward and Forward Linkages

n.	*Commodities*	*Forward Linkages*	*Forward Dispersion*	*Ranks w.r.t Forward Linkages*	*Backward Linkages*	*Backward Dispersion*	*Ranks w.r.t Backward Linkages*	*FD>1 BD>1*
1	Foods and Drinks	90.685	5.387	1	16.679	0.991	38	
2	work construction	59.880	3.557	2	16.991	1.009	28	X
3	Services to real estate	59.507	3.535	3	15.741	0.935	56	
4	Agriculture & Hunting	54.852	3.258	4	16.340	0.971	51	
5	Public administration services	49.179	2.921	5	16.978	1.008	29	X
6	Electricity, gas, steam & hot water	47.009	2.792	6	17.152	1.019	18	X
7	Chemical substances & chemical products	44.281	2.630	7	16.625	0.988	42	
8	Metals	36.608	2.175	8	17.204	1.022	13	X
9	Coke oven products & petroleum products	33.754	2.005	9	16.318	0.969	52	
10	Other services related to entrepreneurial activity	33.089	1.965	10	16.636	0.988	39	
11	Machinery & equipment	31.576	1.876	11	17.394	1.033	7	X
12	Oil and Natural Gas	27.753	1.649	12	15.736	0.935	57	
13	Health services & social services	26.464	1.572	13	17.373	1.032	9	X
14	Motor vehicles	25.812	1.533	14	17.378	1.032	8	X
15	Services Land transport & transport via pipelines	22.211	1.319	15	16.635	0.988	40	
16	Financial intermediation services	21.553	1.280	16	16.468	0.978	48	
17	Transport auxiliary services	16.431	0.976	17	17.092	1.015	22	
18	Fabricated metal products	16.271	0.966	18	17.548	1.042	3	
19	Education services	15.445	0.917	19	17.245	1.024	12	
20	electronic components	14.656	0.871	20	17.053	1.013	25	
21	Other vehicles & equipment	14.512	0.862	21	17.427	1.035	5	
22	Postal & Telecommunications Services	14.469	0.859	22	16.483	0.979	47	
23	Other non-metallic mineral products	14.301	0.849	23	17.300	1.028	11	
24	Rubber & plastics	13.338	0.792	24	17.192	1.021	14	
25	Electrical machines & equipment	12.696	0.754	25	17.512	1.040	4	
26	Clothing	12.042	0.715	26	15.904	0.945	54	
27	Hotel & restaurant services	10.961	0.651	27	16.611	0.987	43	
28	Medical devices	10.118	0.601	28	17.143	1.018	19	
29	Services in organization of leisure	10.085	0.599	29	17.097	1.016	21	
30	Furniture & other manufactured goods	10.025	0.595	30	16.746	0.995	37	
31	Textile	9.737	0.578	31	16.541	0.983	44	
32	Pulp & paper products	9.357	0.556	32	16.955	1.007	32	
33	Software products & services	9.182	0.545	33	16.940	1.006	34	
34	Scientific research & experimental development	8.868	0.527	34	17.167	1.020	16	
35	Rental services of machinery & equipment	8.395	0.499	35	15.810	0.939	55	

36	Tobacco	7.817	0.464	36	15.405	0.915	59
37	Leather & Leather products	6.977	0.414	37	15.641	0.929	58
38	Office equipment & computers	6.660	0.396	38	16.873	1.002	35
39	Services of air & space transport	6.021	0.358	39	17.306	1.028	10
40	Insurance & Private Pensions	5.688	0.338	40	17.156	1.019	17
41	Wood & products of wood	5.432	0.323	41	17.069	1.014	23
42	Recycled materials	5.307	0.315	42	17.601	1.045	1
43	Minning & Quarrying	5.031	0.299	43	16.448	0.977	49
44	Coal	5.010	0.298	44	17.177	1.020	15
45	Printing production & media recorded	4.762	0.283	45	17.125	1.017	20
46	Metal Ores	4.319	0.257	46	17.057	1.013	24
47	Trade, maintenance & repair of motor vehicles	4.187	0.249	47	16.628	0.988	41
48	Services of households as employers	3.967	0.236	48	17.424	1.035	6
49	Collection of waste water and waste	3.506	0.208	49	16.973	1.008	30
50	Foresty	3.326	0.198	50	16.777	0.997	36
51	Services in wholesale trade	3.080	0.183	51	16.439	0.976	50
52	personal services other	3.056	0.182	52	16.253	0.965	53
53	Water is collected & purified	2.813	0.167	53	17.006	1.010	27
54	Fishing	2.605	0.155	54	16.501	0.980	45
55	Services social organizations	2.281	0.135	55	17.567	1.043	2
56	Support services of financial intermediation	1.958	0.116	56	16.958	1.007	31
57	Water transport services	1.866	0.111	57	16.952	1.007	33
58	Retail trade	1.494	0.089	58	16.484	0.979	46
59	Uranium and Thoriam	1.014	0.060	59	17.043	1.012	26

Appendix B-XI

Figure 2. 12 Macro Multiplier with respect to higher to Lower Order



Appendix B-XII

Table 2. 17 Macro Multipliers based on R Matrix

S		*S*	
s1	24.73	s31	1.05
s2	1.95	s32	1.04
s3	1.65	s33	1.03
s4	1.59	s34	1.03
s5	1.51	s35	1.02
s6	1.48	s36	1.01
s7	1.45	s37	1.01
s8	1.37	s38	1.01
s9	1.34	s39	1.01
s10	1.28	s40	1.00
s11	1.26	s41	1.00
s12	1.25	s42	1.00
s13	1.24	s43	1.00
s14	1.22	s44	1.00
s15	1.21	s45	0.98
s16	1.20	s46	0.98
s17	1.20	s47	0.98
s18	1.17	s48	0.98
s19	1.16	s49	0.97
s20	1.15	s50	0.96
s21	1.13	s51	0.96
s22	1.12	s52	0.95
s23	1.11	s53	0.94
s24	1.10	s54	0.93
s25	1.10	s55	0.89
s26	1.09	s56	0.88
s27	1.08	s57	0.83
s28	1.07	s58	0.81
s29	1.06	s59	0.70
s30	1.06		

Appendix B-XIII

Table 2. 18 Effect on total output of policy 1, 46 and combination of policy 1 & 46

Commodities	$s_1.u_1$	*s46.u46*	$\alpha0.1* s_1.u_1+(1-\alpha0.1) * s46.u46$	*Commodities*	$s_1.u_1$	*S46.u46*	$\alpha0.1* s_1.u_1+(1-\alpha0.1) * s46.u46$
1	-7.155	-0.120	-0.823	31	-0.695	-0.010	-0.079
2	-0.428	0.053	0.005	32	-6.134	0.019	-0.596
3	-0.334	-0.020	-0.051	33	-0.366	-0.131	-0.155
4	-0.650	0.019	-0.048	34	-7.801	-0.077	-0.850
5	-3.609	0.047	-0.319	35	-0.539	-0.008	-0.061
6	-0.131	-0.167	-0.164	36	-0.396	0.049	0.004
7	-0.561	0.020	-0.038	37	-0.190	0.023	0.002
8	-0.650	0.038	-0.031	38	-1.427	0.071	-0.079
9	-11.828	0.110	-1.084	39	-2.889	-0.040	-0.325
10	-1.004	0.250	0.125	40	-0.240	-0.075	-0.091
11	-1.261	0.251	0.099	41	-0.782	0.069	-0.016
12	**-1.558**	**-0.694**	**-0.781**	42	-2.139	-0.041	-0.251
13	-0.895	0.054	-0.041	43	-1.880	0.000	-0.188
14	-0.702	-0.014	-0.083	44	-2.805	-0.113	-0.382
15	-1.214	-0.039	-0.157	45	-0.740	-0.104	-0.167
16	-0.616	0.045	-0.021	46	-0.252	0.278	0.225
17	-4.390	-0.016	-0.453	47	-7.744	0.000	-0.774
18	-5.770	0.020	-0.559	48	-1.083	0.129	0.008
19	-1.739	-0.076	-0.243	49	-1.192	-0.002	-0.121
20	-1.865	0.020	-0.168	50	-1.155	-0.167	-0.265
21	-4.778	0.009	-0.470	51	-4.309	0.140	-0.305
22	-2.125	0.006	-0.208	52	-6.406	0.007	-0.635
23	-4.118	0.012	-0.401	53	-2.016	0.027	-0.177
24	-0.861	0.007	-0.080	54	-3.453	-0.030	-0.372
25	-1.657	0.013	-0.154	55	-0.455	0.041	-0.009
26	-1.907	0.000	-0.190	56	-0.299	-0.213	-0.222
27	-1.316	0.022	-0.112	57	-1.313	0.032	-0.103
28	-3.364	0.002	-0.334	58	-0.391	0.114	0.064
29	-1.892	0.007	-0.183	59	-0.522	0.101	0.038
30	-1.301	-0.016	-0.144				

Appendix B-XIV

Figure 2. 13 Convenient policies for Economic Growth

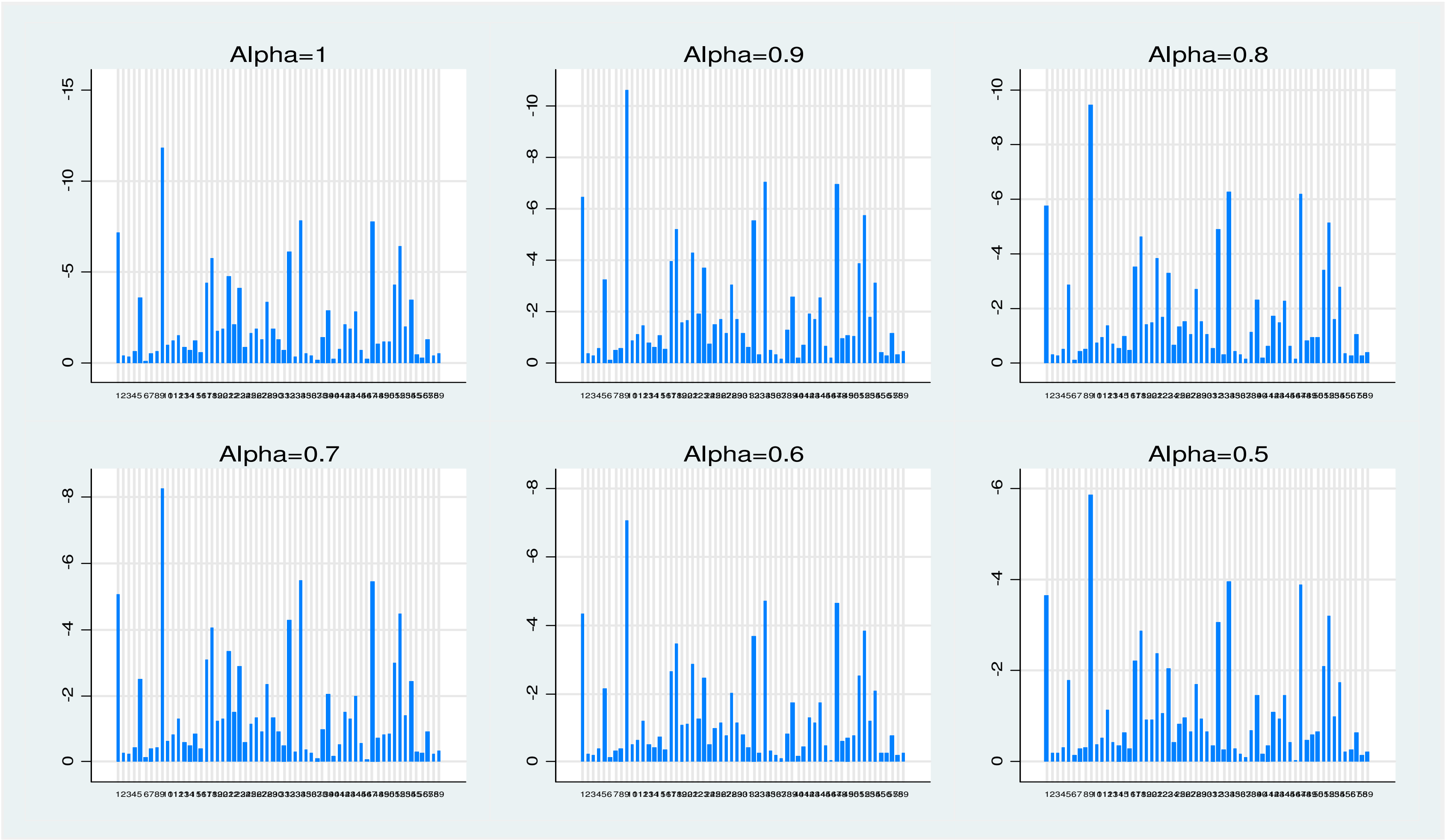
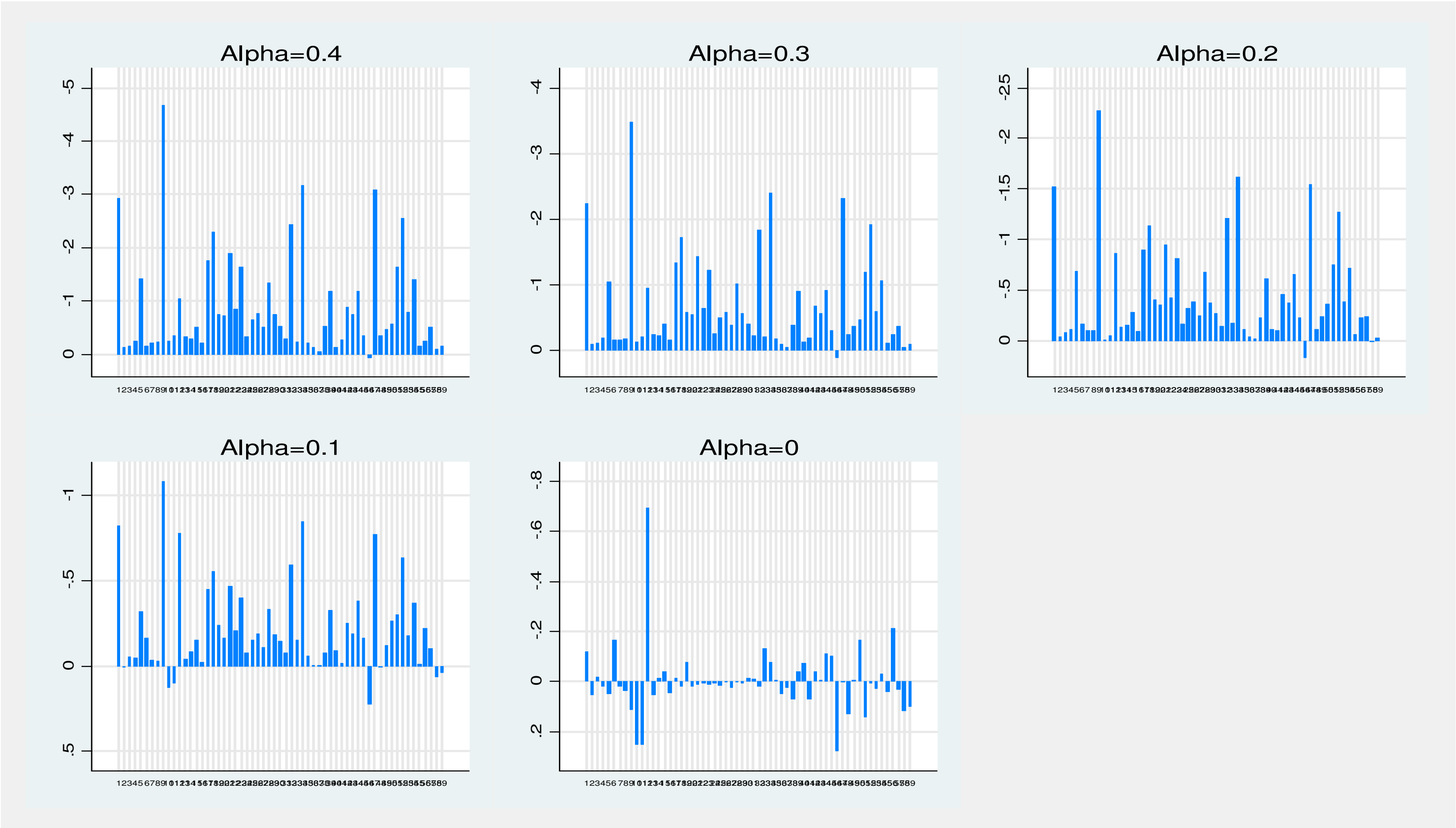


Figure 2.13 (Continued)



Appendix B-XV

Table 2. 19 Final demand effect on total output by Commodities

Effect on total output of a unitary final demand shock				Effect on total output of a final demand w.r.t Structure 1			
x1	67.10	x31	5.31	x1	86.30	x31	6.87
x2	3.63	x32	66.11	x2	4.63	x32	85.15
x3	2.81	x33	3.61	x3	3.57	x33	4.65
x4	5.47	x34	87.30	x4	7.04	x34	112.32
x5	39.53	x35	6.51	x5	50.71	x35	8.34
x6	1.02	x36	9.67	x6	1.32	x36	12.27
x7	4.42	x37	1.86	x7	5.69	x37	2.36
x8	5.97	x38	16.27	x8	7.64	x38	20.94
x9	134.56	x39	54.70	x9	172.99	x39	69.90
x10	12.07	x40	2.38	x10	15.38	x40	3.04
x11	10.34	x41	8.82	x11	13.25	x41	11.35
x12	18.15	x42	33.08	x12	23.24	x42	42.37
x13	9.68	x43	22.49	x13	12.33	x43	28.87
x14	6.80	x44	35.12	x14	8.72	x44	45.03
x15	11.57	x45	8.24	x15	14.83	x45	10.58
x16	7.33	x46	2.45	x16	9.39	x46	3.15
x17	49.55	x47	115.79	x17	63.59	x47	148.32
x18	51.91	x48	14.46	x18	66.87	x48	18.44
x19	18.32	x49	13.53	x19	23.55	x49	17.41
x20	19.37	x50	13.31	x20	24.93	x50	17.10
x21	41.07	x51	63.37	x21	52.92	x51	81.19
x22	20.89	x52	28.91	x22	26.91	x52	39.13
x23	43.07	x53	11.96	x23	55.37	x53	15.89
x24	8.92	x54	21.84	x24	11.42	x54	28.90
x25	16.84	x55	4.34	x25	21.69	x55	5.60
x26	18.23	x56	3.05	x26	23.43	x56	3.96
x27	13.54	x57	11.94	x27	17.44	x57	15.50
x28	36.73	x58	4.19	x28	47.20	x58	5.34
x29	23.27	x59	5.75	x29	29.93	x59	7.44
x30	15.18			x30	19.46		
∑xi		**1393.69**		**∑xi**		**1793.14**	

Appendix B-XVI

Table 2. 20 Direct and Indirect effects of a unitary demand shock on total output by commodities

	f1	f2	f3	f4	f5	f6	f7	f8	f9	f10	f11	f12	f13	f14	f15	f16	f17	f18	f19
x1	1.96	0.72	0.74	0.69	0.73	0.75	0.73	0.72	0.92	0.75	0.68	0.64	0.65	0.70	0.69	0.71	0.73	0.69	0.70
x2	0.03	1.11	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.19	0.08	0.03	0.03	0.03	0.03
x3	0.02	0.02	1.04	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
x4	0.05	0.05	0.05	1.19	0.05	0.06	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05
x5	0.42	0.42	0.46	0.40	1.48	0.46	0.43	0.42	0.39	0.38	0.37	0.35	0.35	0.40	0.40	0.39	0.73	0.44	0.41
x6	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x7	0.04	0.04	0.04	0.03	0.04	0.04	1.06	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.04	0.04	0.04
x8	0.06	0.05	0.05	0.05	0.06	0.06	0.06	1.07	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.07	0.06
x9	1.57	1.44	1.51	1.39	1.47	1.52	1.49	1.46	2.53	1.38	1.33	1.28	1.28	1.41	1.40	1.43	1.48	1.40	1.40
x10	0.12	0.12	0.12	0.11	0.12	0.13	0.12	0.12	0.12	1.13	0.11	0.10	0.10	0.12	0.12	0.12	0.12	0.12	0.11
x11	0.10	0.10	0.12	0.10	0.10	0.11	0.10	0.10	0.10	0.10	1.20	0.14	0.10	0.10	0.10	0.10	0.10	0.10	0.11
x12	0.19	0.19	0.19	0.18	0.19	0.20	0.19	0.19	0.18	0.18	0.17	1.17	0.17	0.18	0.18	0.19	0.19	0.18	0.18
x13	0.10	0.09	0.10	0.09	0.09	0.10	0.10	0.09	0.09	0.09	0.09	0.08	1.12	0.09	0.09	0.09	0.10	0.09	0.09
x14	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	1.15	0.07	0.06	0.06	0.06	0.06
x15	0.11	0.11	0.12	0.10	0.11	0.11	0.11	0.11	0.12	0.13	0.10	0.09	0.09	0.12	1.29	0.29	0.11	0.11	0.11
x16	0.07	0.06	0.07	0.06	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	1.23	0.07	0.06	0.06
x17	0.54	0.60	0.70	0.53	0.52	0.60	0.55	0.55	0.49	0.47	0.46	0.44	0.44	0.53	0.51	0.49	1.61	0.57	0.52
x18	0.64	0.58	0.59	0.57	0.59	0.66	0.60	0.59	0.59	0.57	0.63	0.53	0.53	0.63	0.64	0.64	0.61	1.71	0.97
x19	0.19	0.18	0.19	0.18	0.18	0.19	0.19	0.18	0.18	0.17	0.17	0.16	0.16	0.18	0.18	0.19	0.18	0.18	1.23
x20	0.21	0.20	0.21	0.20	0.21	0.22	0.21	0.21	0.20	0.20	0.19	0.18	0.18	0.20	0.20	0.20	0.21	0.20	0.21
x21	0.43	0.42	0.43	0.42	0.44	0.46	0.47	0.44	0.41	0.41	0.38	0.37	0.37	0.41	0.42	0.41	0.44	0.42	0.42
x22	0.23	0.22	0.23	0.22	0.22	0.23	0.24	0.23	0.22	0.21	0.20	0.19	0.19	0.22	0.21	0.21	0.22	0.21	0.21
x23	0.48	0.48	0.49	0.49	0.47	0.51	0.52	0.50	0.45	0.44	0.41	0.40	0.40	0.46	0.46	0.45	0.47	0.45	0.45
x24	0.09	0.08	0.09	0.08	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.08	0.08	0.09	0.09	0.08	0.08
x25	0.17	0.17	0.17	0.17	0.18	0.18	0.18	0.17	0.16	0.16	0.15	0.15	0.15	0.17	0.17	0.16	0.18	0.17	0.16
x26	0.19	0.18	0.19	0.18	0.19	0.19	0.19	0.19	0.18	0.18	0.17	0.16	0.16	0.18	0.18	0.19	0.19	0.18	0.18
x27	0.15	0.14	0.15	0.14	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.14	0.14	0.14	0.15	0.14	0.14
x28	0.39	0.40	0.39	0.37	0.39	0.40	0.39	0.39	0.37	0.36	0.34	0.33	0.33	0.37	0.37	0.37	0.39	0.37	0.37

Table 2.20 (Continue)

	f1	f2	f3	f4	f5	f6	f7	f8	f9	f10	f11	f12	f13	f14	f15	f16	f17	f18	f19
x29	0.25	0.24	0.26	0.24	0.25	0.27	0.27	0.26	0.24	0.24	0.22	0.22	0.22	0.24	0.24	0.24	0.26	0.24	0.24
x30	0.16	0.15	0.16	0.15	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.15	0.15	0.15	0.16	0.15	0.15
x31	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.07	0.05	0.04	0.04	0.05
x32	0.74	0.72	0.72	0.71	0.74	0.87	0.83	0.76	0.70	0.68	0.68	0.64	0.64	0.74	0.76	0.72	0.74	0.74	0.73
x33	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
x34	1.05	1.00	1.04	0.97	1.07	1.02	1.01	1.03	0.99	1.01	0.94	0.92	0.92	0.98	0.99	0.98	1.07	1.00	0.98
x35	0.06	0.06	0.06	0.06	0.06	0.08	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06
x36	0.07	0.07	0.07	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.06	0.06	0.06	0.07	0.06	0.06
x37	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
x38	0.18	0.17	0.18	0.17	0.18	0.19	0.18	0.17	0.17	0.17	0.16	0.16	0.15	0.17	0.17	0.17	0.18	0.17	0.17
x39	0.50	0.51	0.49	0.51	0.52	0.51	0.50	0.50	0.47	0.44	0.43	0.41	0.41	0.49	0.48	0.47	0.55	0.49	0.47
x40	0.01	0.02	0.04	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.01	0.01
x41	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09
x42	0.32	0.33	0.31	0.34	0.31	0.32	0.35	0.33	0.30	0.28	0.27	0.26	0.26	0.31	0.31	0.30	0.35	0.31	0.30
x43	0.24	0.23	0.24	0.23	0.24	0.25	0.24	0.24	0.23	0.22	0.22	0.21	0.21	0.23	0.23	0.24	0.24	0.23	0.23
x44	0.35	0.35	0.36	0.34	0.35	0.36	0.37	0.35	0.33	0.32	0.31	0.30	0.30	0.35	0.34	0.34	0.36	0.34	0.34
x45	0.08	0.08	0.08	0.07	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.07	0.07
x46	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
x47	1.14	1.11	1.14	1.08	1.15	1.18	1.14	1.13	1.08	1.06	1.02	0.99	0.99	1.10	1.09	1.12	1.16	1.09	1.09
x48	0.13	0.15	0.17	0.13	0.14	0.13	0.14	0.14	0.13	0.12	0.12	0.11	0.11	0.14	0.13	0.13	0.14	0.13	0.13
x49	0.14	0.14	0.14	0.14	0.15	0.14	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.14	0.14	0.15	0.15	0.14	0.14
x50	0.15	0.14	0.14	0.13	0.15	0.14	0.14	0.14	0.14	0.14	0.13	0.12	0.13	0.13	0.14	0.13	0.15	0.14	0.13
x51	0.62	0.60	0.61	0.60	0.62	0.67	0.62	0.62	0.60	0.57	0.55	0.54	0.53	0.59	0.60	0.62	0.64	0.60	0.60
x52	0.97	0.99	0.97	1.02	0.98	0.94	0.96	0.98	1.02	1.04	1.07	1.10	1.10	1.01	1.02	1.00	0.97	1.02	1.02
x53	0.28	0.29	0.28	0.29	0.28	0.28	0.28	0.28	0.29	0.30	0.30	0.31	0.31	0.29	0.29	0.29	0.28	0.29	0.29
x54	0.50	0.50	0.50	0.51	0.50	0.48	0.49	0.50	0.51	0.51	0.52	0.53	0.53	0.51	0.51	0.50	0.50	0.51	0.51
x55	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
x56	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
x57	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.16	0.17	0.17	0.17	0.17	0.17	0.17
x58	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.03
x59	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05
Sum	**17.06**	**16.63**	**16.97**	**16.30**	**16.74**	**17.21**	**16.92**	**16.68**	**16.43**	**15.90**	**15.54**	**14.98**	**14.96**	**16.53**	**16.53**	**16.61**	**17.24**	**16.42**	**16.57**

Table 2.20 (Continue)

	f20	f21	f22	f23	f24	f25	f26	f27	f28	f29	f30	f31	f32	f33	f34	f35	f36	f37	f38
x1	0.70	0.71	0.71	0.70	0.64	0.70	0.67	0.70	0.68	0.76	0.67	0.70	0.74	0.75	0.73	0.96	4.63	19.27	0.81
x2	0.03	0.03	0.03	0.02	0.02	0.03	0.02	0.02	0.02	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.16	0.66	0.03
x3	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.12	0.48	0.03
x4	0.06	0.09	0.06	0.05	0.04	0.06	0.04	0.05	0.05	0.05	0.05	0.06	0.09	0.06	0.05	0.06	0.28	1.16	0.05
x5	0.42	0.43	0.41	0.39	0.35	0.40	0.37	0.38	0.38	0.42	0.38	0.40	0.71	0.49	0.42	0.52	3.02	11.32	0.41
x6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
x7	0.04	0.13	0.07	0.04	0.03	0.05	0.03	0.04	0.04	0.05	0.04	0.07	0.04	0.04	0.04	0.05	0.23	0.91	0.04
x8	0.12	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.09	0.05	0.06	0.06	0.08	0.07	0.34	1.34	0.06
x9	1.42	1.44	1.43	1.41	1.29	1.42	1.36	1.42	1.38	1.53	1.36	1.41	1.50	1.51	1.48	1.95	9.33	39.66	1.67
x10	0.12	0.12	0.12	0.12	0.11	0.12	0.11	0.12	0.11	0.13	0.11	0.12	0.12	0.12	0.12	0.16	0.79	3.33	0.12
x11	0.10	0.10	0.10	0.10	0.09	0.10	0.09	0.10	0.10	0.11	0.11	0.10	0.10	0.10	0.11	0.14	0.64	2.65	0.11
x12	0.19	0.19	0.19	0.19	0.17	0.19	0.18	0.18	0.18	0.20	0.18	0.18	0.20	0.20	0.19	0.25	1.19	5.02	0.20
x13	0.09	0.09	0.09	0.09	0.08	0.09	0.09	0.09	0.09	0.10	0.09	0.09	0.10	0.10	0.10	0.13	0.61	2.60	0.10
x14	0.07	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.06	0.07	0.12	0.06	0.06	0.06	0.08	0.08	0.39	1.65	0.06
x15	0.12	0.10	0.11	0.10	0.09	0.11	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.11	0.14	0.74	3.20	0.12
x16	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.06	0.06	0.07	0.07	0.07	0.10	0.46	1.81	0.07
x17	0.53	0.54	0.51	0.49	0.44	0.50	0.46	0.48	0.48	0.54	0.48	0.51	0.54	0.53	0.54	0.68	3.65	14.43	0.51
x18	0.63	0.60	0.61	0.59	0.53	0.62	0.56	0.58	0.59	0.63	0.59	0.58	0.59	0.62	0.62	0.77	3.19	12.70	0.60
x19	0.19	0.18	0.19	0.19	0.16	0.20	0.17	0.18	0.21	0.20	0.19	0.17	0.18	0.19	0.23	0.26	1.20	5.49	0.19
x20	1.33	0.22	0.21	0.20	0.18	0.21	0.19	0.20	0.21	0.22	0.20	0.21	0.21	0.21	0.33	0.28	1.25	5.07	0.21
x21	0.46	1.71	0.81	0.55	0.39	0.68	0.42	0.46	0.49	0.57	0.46	0.96	0.44	0.44	0.53	0.61	2.77	10.89	0.43
x22	0.23	0.22	1.27	0.27	0.20	0.23	0.21	0.23	0.24	0.27	0.22	0.22	0.23	0.23	0.29	0.32	1.41	5.59	0.22
x23	0.47	0.49	0.48	1.55	0.40	0.47	0.43	0.46	0.46	0.55	0.43	0.46	0.47	0.48	0.48	0.64	2.99	12.31	0.46
x24	0.08	0.08	0.08	0.08	1.16	0.08	0.08	0.08	0.08	0.09	0.08	0.08	0.09	0.09	0.09	0.11	0.55	2.34	0.09
x25	0.17	0.18	0.18	0.20	0.16	1.28	0.18	0.21	0.19	0.22	0.16	0.17	0.19	0.18	0.20	0.26	1.12	4.50	0.17
x26	0.18	0.18	0.18	0.18	0.23	0.20	1.36	0.26	0.18	0.22	0.17	0.18	0.19	0.19	0.19	0.25	1.18	4.83	0.19
x27	0.14	0.15	0.15	0.15	0.14	0.15	0.15	1.23	0.14	0.19	0.14	0.14	0.15	0.15	0.15	0.19	0.81	3.17	0.15
x28	0.37	0.38	0.38	0.37	0.34	0.37	0.35	0.37	1.72	0.40	0.35	0.37	0.39	0.39	0.39	0.89	2.57	10.53	0.39

Table 2.20 (Continue)

	f20	f21	f22	f23	f24	f25	f26	f27	f28	f29	f30	f31	f32	f33	f34	f35	f36	f37	f38
x29	0.24	0.25	0.24	0.24	0.22	0.24	0.23	0.24	0.23	1.48	0.23	0.24	0.26	0.25	0.25	0.32	1.62	6.18	0.25
x30	0.15	0.15	0.15	0.15	0.14	0.15	0.14	0.15	0.15	0.16	1.15	0.15	0.16	0.16	0.16	0.21	1.00	4.28	0.16
x31	0.06	0.13	0.09	0.05	0.04	0.06	0.04	0.05	0.05	0.06	0.05	1.20	0.04	0.04	0.05	0.06	0.30	1.14	0.04
x32	0.81	0.82	0.77	0.73	0.65	0.75	0.68	0.71	0.71	0.78	0.69	0.75	2.24	0.99	0.75	0.92	3.94	17.98	0.75
x33	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	1.04	0.03	0.04	0.16	0.69	0.03
x34	0.99	1.01	0.99	0.97	0.92	0.98	0.95	0.97	0.97	1.03	0.96	0.99	1.05	1.04	2.04	1.30	5.66	22.80	1.05
x35	0.06	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.06	1.15	0.39	1.53	0.06
x36	0.06	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.06	0.08	0.06	0.06	0.06	0.06	0.06	0.08	1.97	4.13	0.06
x37	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.06	1.29	0.01
x38	0.17	0.17	0.17	0.17	0.16	0.17	0.16	0.17	0.17	0.18	0.16	0.17	0.18	0.18	0.18	0.23	1.00	4.14	1.18
x39	0.49	0.49	0.48	0.47	0.42	0.47	0.44	0.45	0.45	0.52	0.44	0.47	0.49	0.48	0.49	0.66	6.24	19.68	0.48
x40	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.11	0.41	0.01
x41	0.09	0.09	0.09	0.09	0.08	0.09	0.09	0.09	0.09	0.10	0.09	0.09	0.09	0.09	0.09	0.11	0.49	2.01	0.09
x42	0.32	0.32	0.31	0.30	0.27	0.30	0.28	0.29	0.29	0.33	0.28	0.31	0.31	0.30	0.31	0.48	3.20	10.60	0.30
x43	0.23	0.23	0.23	0.23	0.21	0.23	0.22	0.23	0.23	0.25	0.22	0.23	0.24	0.25	0.24	0.31	1.40	6.05	0.24
x44	0.35	0.35	0.35	0.34	0.31	0.35	0.32	0.34	0.33	0.37	0.32	0.35	0.36	0.36	0.36	0.49	2.47	11.28	0.37
x45	0.08	0.08	0.08	0.07	0.07	0.08	0.07	0.07	0.07	0.08	0.07	0.08	0.08	0.08	0.08	0.10	0.51	2.12	0.08
x46	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.09	0.40	0.01
x47	1.11	1.11	1.12	1.10	1.01	1.10	1.05	1.09	1.07	1.18	1.06	1.09	1.16	1.17	1.14	1.64	7.88	41.26	1.22
x48	0.14	0.13	0.13	0.13	0.11	0.13	0.12	0.12	0.12	0.14	0.12	0.13	0.14	0.14	0.15	0.19	1.18	4.34	0.13
x49	0.14	0.14	0.14	0.14	0.15	0.14	0.14	0.14	0.14	0.15	0.14	0.14	0.15	0.15	0.14	0.19	0.76	3.08	0.15
x50	0.13	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.14	0.13	0.13	0.14	0.14	0.14	0.19	0.87	3.52	0.14
x51	0.61	0.61	0.61	0.60	0.55	0.60	0.58	0.61	0.59	0.68	0.57	0.60	0.63	0.65	0.62	0.99	5.17	21.27	0.66
x52	1.00	0.99	0.99	1.01	1.09	1.00	1.04	1.00	1.03	0.93	1.05	1.01	0.95	0.94	0.96	0.66	-3.99	-23.26	0.96
x53	0.29	0.29	0.29	0.29	0.31	0.29	0.30	0.29	0.30	0.28	0.30	0.29	0.28	0.28	0.28	0.22	-0.70	-4.48	0.28
x54	0.50	0.50	0.50	0.50	0.53	0.50	0.51	0.50	0.51	0.48	0.52	0.51	0.49	0.49	0.49	0.41	-0.92	-6.39	0.49
x55	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.05	0.07	0.04	0.05	0.14	0.57	0.05
x56	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.15	0.62	0.02
x57	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.18	0.33	0.85	0.17
x58	0.04	0.04	0.04	0.03	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.03	0.04	0.04	0.04	0.05	0.21	0.90	0.04
x59	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.07	0.34	1.43	0.05
Sum	**16.73**	**17.06**	**16.94**	**16.47**	**15.23**	**16.72**	**15.84**	**16.29**	**16.43**	**17.61**	**15.92**	**16.93**	**17.59**	**17.12**	**17.11**	**21.34**	**87.64**	**347.38**	**17.03**

Table 2.20 (Continue)

	f39	f40	f41	f42	f43	f44	f45	f46	f47	f48	f49	f50	f51	f52	f53	f54	f55	f56	f57	f58	f59	x	f
x1	0.78	0.80	0.75	0.76	0.74	0.75	0.75	0.76	0.74	0.75	0.76	0.75	0.76	0.77	0.77	0.78	0.75	0.78	0.76	0.77	0.79	67.10	1
x2	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	3.63	1
x3	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	2.81	1
x4	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	5.47	1
x5	0.48	0.50	0.48	0.44	0.40	0.39	0.40	0.39	0.41	0.42	0.40	0.41	0.41	0.41	0.40	0.41	0.46	0.40	0.41	0.41	0.39	39.53	1
x6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.02	1
x7	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.04	0.03	0.03	0.04	0.03	4.42	1
x8	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.06	0.06	0.05	0.05	0.06	0.06	0.05	0.06	0.07	0.05	0.06	0.06	0.05	5.97	1
x9	1.58	1.62	1.53	1.54	1.50	1.52	1.53	1.54	1.49	1.51	1.54	1.52	1.53	1.56	1.58	1.58	1.51	1.58	1.55	1.51	1.61	134.56	1
x10	0.13	0.13	0.13	0.13	0.12	0.13	0.13	0.13	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.13	0.12	0.13	0.13	0.12	0.13	12.07	1
x11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.11	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.11	0.11	0.11	0.11	10.34	1
x12	0.21	0.21	0.20	0.20	0.19	0.20	0.20	0.20	0.19	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.21	18.15	1
x13	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	9.68	1
x14	0.07	0.07	0.06	0.07	0.06	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.06	6.80	1
x15	0.11	0.12	0.11	0.11	0.11	0.11	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.13	0.11	0.11	0.11	11.57	1
x16	0.07	0.07	0.07	0.07	0.07	0.07	0.09	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.13	0.08	0.07	0.07	7.33	1
x17	0.65	0.79	0.76	0.59	0.51	0.50	0.51	0.50	0.51	0.53	0.51	0.51	0.52	0.53	0.51	0.52	0.58	0.52	0.51	0.52	0.50	49.55	1
x18	0.62	0.63	0.60	0.61	0.59	0.59	0.59	0.59	0.60	0.60	0.60	0.61	0.61	0.60	0.60	0.72	0.62	0.61	0.61	0.63	0.59	51.91	1
x19	0.20	0.20	0.19	0.19	0.18	0.18	0.18	0.18	0.19	0.19	0.18	0.19	0.19	0.18	0.18	0.18	0.19	0.18	0.18	0.18	0.18	18.32	1
x20	0.22	0.23	0.21	0.22	0.21	0.20	0.20	0.20	0.22	0.21	0.20	0.21	0.21	0.21	0.20	0.20	0.23	0.21	0.21	0.21	0.19	19.37	1
x21	0.46	0.48	0.45	0.45	0.43	0.41	0.41	0.41	0.44	0.44	0.42	0.46	0.43	0.42	0.41	0.41	0.44	0.41	0.42	0.43	0.39	41.07	1
x22	0.24	0.25	0.23	0.23	0.22	0.21	0.22	0.21	0.23	0.23	0.22	0.23	0.22	0.22	0.21	0.22	0.23	0.22	0.22	0.22	0.21	20.89	1
x23	0.50	0.53	0.48	0.48	0.46	0.45	0.45	0.44	0.48	0.48	0.46	0.48	0.47	0.45	0.44	0.45	0.50	0.45	0.46	0.48	0.43	43.07	1
x24	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.09	0.09	0.09	0.13	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.08	8.92	1
x25	0.19	0.20	0.19	0.19	0.18	0.17	0.17	0.17	0.18	0.18	0.18	0.21	0.18	0.17	0.17	0.17	0.18	0.17	0.17	0.17	0.16	16.84	1
x26	0.20	0.20	0.20	0.19	0.25	0.19	0.20	0.19	0.19	0.20	0.22	0.25	0.20	0.19	0.19	0.19	0.19	0.19	0.22	0.19	0.18	18.23	1
x27	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.14	0.15	0.15	0.15	0.22	0.16	0.14	0.14	0.16	0.15	0.14	0.15	0.15	0.14	13.54	1
x28	0.43	0.42	0.40	0.41	0.39	0.39	0.39	0.39	0.39	0.40	0.39	0.39	0.39	0.39	0.39	0.39	0.40	0.39	0.39	0.39	0.39	36.73	1

Table 2.20 (Continue)

	f39	f40	f41	f42	f43	f44	f45	f46	f47	f48	f49	f50	f51	f52	f53	f54	f55	f56	f57	f58	f59	x	f
x29	0.30	0.33	0.33	0.28	0.25	0.24	0.24	0.24	0.26	0.27	0.25	0.30	0.25	0.25	0.23	0.23	0.25	0.24	0.24	0.25	0.22	23.27	1
x30	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.16	15.18	1
x31	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	5.31	1
x32	0.83	0.78	0.74	0.76	0.74	0.72	0.72	0.72	0.76	0.74	0.73	0.75	0.73	0.75	0.78	0.77	0.86	0.75	0.76	0.76	0.70	66.11	1
x33	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03	3.61	1
x34	1.10	1.09	1.04	1.04	1.04	1.01	1.00	0.98	1.10	1.08	1.01	1.02	1.03	1.05	0.99	1.00	1.06	0.99	1.04	1.05	0.91	87.30	1
x35	0.07	0.07	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	6.51	1
x36	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	9.67	1
x37	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.86	1
x38	0.19	0.19	0.19	0.19	0.18	0.18	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.19	0.19	0.19	0.18	0.23	0.19	0.18	0.19	16.27	1
x39	1.58	0.55	0.54	0.62	0.48	0.47	0.47	0.47	0.49	0.50	0.49	0.48	0.49	0.49	0.47	0.48	0.49	0.49	0.48	0.48	0.47	54.70	1
x40	0.01	1.04	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	2.38	1
x41	0.10	0.10	1.14	0.11	0.09	0.09	0.10	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.09	0.09	0.09	0.10	0.10	0.09	0.09	8.82	1
x42	0.38	0.42	0.63	1.48	0.30	0.29	0.30	0.29	0.31	0.33	0.30	0.31	0.31	0.33	0.30	0.30	0.31	0.32	0.30	0.30	0.29	33.08	1
x43	0.26	0.26	0.25	0.25	1.47	0.26	0.28	0.26	0.24	0.24	0.28	0.25	0.25	0.26	0.25	0.25	0.24	0.27	0.27	0.25	0.25	22.49	1
x44	0.38	0.39	0.38	0.38	0.35	1.43	0.43	0.46	0.35	0.36	0.37	0.36	0.36	0.36	0.35	0.35	0.36	0.40	0.36	0.35	0.34	35.12	1
x45	0.09	0.09	0.08	0.08	0.08	0.08	1.29	0.10	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	8.24	1
x46	0.02	0.02	0.01	0.01	0.01	0.03	0.13	1.04	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	2.45	1
x47	1.31	1.26	1.19	1.23	1.20	1.20	1.24	1.22	2.20	1.17	1.22	1.17	1.20	1.18	1.18	1.17	1.17	1.24	1.21	1.24	1.18	115.79	1
x48	0.20	0.30	0.23	0.17	0.13	0.12	0.13	0.12	0.13	1.16	0.13	0.13	0.14	0.13	0.13	0.13	0.15	0.13	0.14	0.13	0.12	14.46	1
x49	0.15	0.15	0.15	0.15	0.17	0.19	0.18	0.19	0.15	0.15	1.34	0.17	0.16	0.17	0.15	0.15	0.15	0.16	0.15	0.15	0.14	13.53	1
x50	0.15	0.15	0.14	0.14	0.14	0.14	0.14	0.13	0.15	0.15	0.14	1.17	0.14	0.14	0.13	0.13	0.14	0.13	0.14	0.14	0.12	13.31	1
x51	0.66	0.66	0.65	0.65	0.66	0.67	0.72	0.67	0.64	0.63	0.66	0.73	1.73	0.63	0.61	0.61	0.63	0.65	0.69	0.63	0.58	63.37	1
x52	0.90	0.88	0.94	0.93	0.95	0.94	0.93	0.92	0.96	0.95	0.92	0.93	0.93	1.91	0.89	0.91	0.94	0.91	0.92	0.95	0.85	28.91	1
x53	0.27	0.26	0.28	0.28	0.28	0.28	0.28	0.27	0.28	0.28	0.27	0.28	0.28	0.27	1.28	0.27	0.28	0.28	0.27	0.28	0.26	11.96	1
x54	0.48	0.47	0.48	0.48	0.49	0.48	0.48	0.48	0.49	0.49	0.48	0.48	0.48	0.48	0.47	1.48	0.49	0.49	0.48	0.49	0.46	21.84	1
x55	0.05	0.05	0.05	0.05	0.05	0.04	0.05	0.04	0.05	0.04	0.04	0.05	0.05	0.06	0.05	0.05	1.08	0.05	0.05	0.05	0.04	4.34	1
x56	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.02	0.02	0.02	0.02	3.05	1
x57	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.21	0.17	0.17	0.16	0.17	0.25	1.25	0.17	0.16	11.94	1
x58	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	1.04	0.04	4.19	1
x59	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.05	0.05	1.06	5.75	1
Sum	**17.88**	**18.26**	**17.80**	**17.49**	**16.97**	**16.67**	**17.19**	**16.72**	**16.87**	**16.89**	**17.00**	**17.11**	**16.96**	**16.81**	**16.54**	**16.76**	**17.10**	**17.10**	**16.96**	**16.87**	**16.15**	**1393.69**	**59**

Appendix B-XVII

Table 2. 21 Direct and Indirect effects of final demand shocks by the structure 1 on total output by Commodities

	f1	f2	f3	f4	f5	f6	f7	f8	f9	f10	f11	f12	f13	f14	f15	f16	f17	f18	f19
x1	2.70	0.90	0.93	0.88	0.90	0.96	0.95	0.90	1.37	0.88	0.85	0.77	0.77	0.89	0.88	0.90	0.94	0.93	0.93
x2	0.04	1.40	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.24	0.10	0.04	0.03	0.03	0.03
x3	0.03	0.03	1.29	0.03	0.03	0.03	0.03	0.03	0.04	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
x4	0.07	0.06	0.06	1.53	0.06	0.08	0.07	0.06	0.07	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.07	0.06	0.06
x5	0.57	0.53	0.57	0.51	1.84	0.59	0.56	0.52	0.58	0.44	0.46	0.42	0.41	0.51	0.52	0.50	0.95	0.60	0.54
x6	0.00	0.00	0.00	0.00	0.00	1.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
x7	0.05	0.04	0.04	0.04	0.05	0.05	1.37	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05
x8	0.08	0.07	0.07	0.07	0.07	0.07	0.07	1.33	0.08	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.09	0.08
x9	2.16	1.81	1.88	1.79	1.83	1.96	1.92	1.82	3.76	1.63	1.68	1.56	1.53	1.79	1.79	1.82	1.91	1.89	1.85
x10	0.17	0.15	0.15	0.15	0.15	0.16	0.16	0.15	0.17	1.33	0.14	0.13	0.12	0.15	0.15	0.15	0.16	0.16	0.15
x11	0.14	0.13	0.14	0.12	0.13	0.14	0.13	0.13	0.15	0.11	1.51	0.17	0.12	0.13	0.13	0.13	0.13	0.13	0.14
x12	0.26	0.24	0.24	0.23	0.24	0.26	0.25	0.24	0.27	0.21	0.22	1.43	0.20	0.23	0.23	0.24	0.25	0.24	0.24
x13	0.13	0.12	0.12	0.12	0.12	0.13	0.12	0.12	0.13	0.10	0.11	0.10	1.33	0.12	0.12	0.12	0.12	0.12	0.12
x14	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.07	0.07	0.07	0.06	1.47	0.09	0.08	0.08	0.08	0.08
x15	0.15	0.14	0.14	0.13	0.13	0.14	0.14	0.13	0.18	0.16	0.13	0.11	0.11	0.16	1.64	0.37	0.14	0.14	0.15
x16	0.09	0.08	0.08	0.08	0.08	0.09	0.08	0.08	0.10	0.07	0.08	0.07	0.07	0.08	0.08	1.57	0.09	0.09	0.08
x17	0.74	0.75	0.87	0.68	0.65	0.77	0.72	0.69	0.74	0.55	0.58	0.53	0.52	0.67	0.65	0.63	2.08	0.77	0.68
x18	0.88	0.73	0.74	0.73	0.73	0.84	0.78	0.73	0.88	0.68	0.80	0.64	0.63	0.80	0.82	0.82	0.78	2.30	1.29
x19	0.26	0.23	0.23	0.23	0.22	0.24	0.24	0.23	0.27	0.21	0.21	0.19	0.19	0.23	0.23	0.24	0.24	0.24	1.64
x20	0.29	0.25	0.26	0.25	0.26	0.28	0.27	0.26	0.30	0.23	0.24	0.22	0.22	0.26	0.25	0.25	0.27	0.27	0.28
x21	0.59	0.53	0.54	0.53	0.55	0.59	0.61	0.55	0.61	0.48	0.48	0.45	0.44	0.53	0.54	0.53	0.56	0.56	0.56
x22	0.31	0.28	0.28	0.28	0.28	0.29	0.31	0.28	0.32	0.24	0.25	0.23	0.23	0.28	0.27	0.27	0.29	0.29	0.28
x23	0.67	0.61	0.61	0.62	0.58	0.66	0.68	0.63	0.66	0.52	0.52	0.48	0.47	0.58	0.59	0.57	0.61	0.60	0.59
x24	0.12	0.11	0.11	0.10	0.11	0.11	0.11	0.11	0.12	0.10	0.10	0.09	0.09	0.10	0.10	0.11	0.11	0.11	0.11
x25	0.24	0.21	0.22	0.22	0.22	0.24	0.23	0.22	0.24	0.19	0.19	0.18	0.18	0.21	0.21	0.21	0.23	0.22	0.22
x26	0.26	0.23	0.24	0.23	0.24	0.24	0.24	0.23	0.27	0.21	0.21	0.20	0.20	0.23	0.23	0.24	0.25	0.24	0.24
x27	0.20	0.18	0.19	0.18	0.19	0.19	0.19	0.18	0.21	0.17	0.17	0.16	0.16	0.18	0.18	0.18	0.19	0.19	0.19
x28	0.54	0.50	0.48	0.47	0.48	0.51	0.51	0.48	0.55	0.43	0.44	0.41	0.40	0.47	0.47	0.47	0.50	0.49	0.49

Table 2.21 (Continue)

	f1	f2	f3	f4	f5	f6	f7	f8	f9	f10	f11	f12	f13	f14	f15	f16	f17	f18	f19
x29	0.35	0.30	0.33	0.31	0.32	0.35	0.35	0.33	0.35	0.28	0.28	0.26	0.26	0.30	0.30	0.30	0.33	0.32	0.31
x30	0.22	0.19	0.19	0.19	0.19	0.20	0.20	0.19	0.22	0.17	0.18	0.17	0.16	0.19	0.19	0.19	0.20	0.20	0.20
x31	0.06	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.04	0.05	0.09	0.06	0.06	0.06	0.06
x32	1.01	0.90	0.90	0.91	0.92	1.12	1.07	0.95	1.04	0.80	0.86	0.78	0.76	0.94	0.97	0.91	0.96	1.00	0.97
x33	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04
x34	1.45	1.26	1.29	1.25	1.33	1.31	1.30	1.29	1.48	1.20	1.19	1.12	1.10	1.25	1.26	1.25	1.38	1.35	1.30
x35	0.08	0.08	0.08	0.08	0.08	0.10	0.08	0.08	0.09	0.07	0.07	0.06	0.06	0.08	0.07	0.07	0.08	0.08	0.08
x36	0.10	0.08	0.08	0.08	0.09	0.08	0.08	0.08	0.10	0.07	0.07	0.06	0.06	0.08	0.08	0.08	0.09	0.08	0.08
x37	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
x38	0.24	0.22	0.22	0.21	0.22	0.24	0.23	0.22	0.25	0.19	0.20	0.19	0.18	0.21	0.21	0.22	0.23	0.23	0.22
x39	0.69	0.65	0.61	0.66	0.64	0.66	0.65	0.62	0.70	0.52	0.54	0.50	0.49	0.62	0.61	0.60	0.71	0.66	0.62
x40	0.02	0.02	0.05	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
x41	0.13	0.11	0.12	0.11	0.11	0.12	0.12	0.12	0.13	0.10	0.11	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.12
x42	0.43	0.41	0.39	0.44	0.39	0.41	0.45	0.41	0.44	0.33	0.34	0.32	0.31	0.40	0.40	0.38	0.45	0.42	0.39
x43	0.33	0.29	0.30	0.29	0.30	0.32	0.31	0.30	0.34	0.26	0.27	0.26	0.25	0.29	0.29	0.30	0.31	0.31	0.30
x44	0.49	0.44	0.44	0.43	0.43	0.47	0.47	0.43	0.50	0.38	0.40	0.36	0.35	0.44	0.44	0.44	0.46	0.45	0.45
x45	0.11	0.09	0.10	0.09	0.09	0.10	0.10	0.09	0.11	0.08	0.09	0.08	0.08	0.09	0.09	0.10	0.10	0.10	0.10
x46	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
x47	1.57	1.40	1.42	1.38	1.43	1.52	1.47	1.40	1.61	1.25	1.29	1.21	1.18	1.40	1.38	1.43	1.49	1.46	1.44
x48	0.18	0.18	0.21	0.17	0.18	0.17	0.18	0.17	0.19	0.14	0.15	0.13	0.13	0.17	0.16	0.17	0.18	0.17	0.17
x49	0.20	0.18	0.18	0.18	0.18	0.19	0.19	0.18	0.21	0.16	0.17	0.16	0.16	0.18	0.18	0.19	0.19	0.19	0.19
x50	0.20	0.17	0.18	0.17	0.18	0.18	0.18	0.18	0.20	0.16	0.16	0.15	0.15	0.17	0.17	0.17	0.19	0.18	0.18
x51	0.85	0.76	0.76	0.77	0.77	0.86	0.81	0.78	0.90	0.67	0.70	0.66	0.63	0.75	0.76	0.79	0.82	0.81	0.80
x52	1.33	1.25	1.20	1.31	1.22	1.21	1.24	1.22	1.52	1.22	1.35	1.34	1.31	1.29	1.30	1.27	1.26	1.37	1.36
x53	0.39	0.36	0.35	0.38	0.35	0.36	0.36	0.36	0.44	0.35	0.38	0.37	0.37	0.37	0.37	0.37	0.37	0.39	0.39
x54	0.68	0.63	0.62	0.65	0.62	0.62	0.63	0.62	0.76	0.61	0.66	0.65	0.63	0.64	0.65	0.64	0.64	0.68	0.68
x55	0.06	0.05	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06
x56	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
x57	0.23	0.21	0.21	0.21	0.21	0.22	0.22	0.21	0.25	0.20	0.21	0.20	0.20	0.21	0.21	0.22	0.22	0.23	0.22
x58	0.05	0.04	0.05	0.04	0.04	0.05	0.05	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05
x59	0.07	0.06	0.07	0.06	0.06	0.07	0.07	0.06	0.07	0.06	0.06	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.07
Sum	**23.44**	**20.89**	**21.13**	**20.91**	**20.80**	**22.19**	**21.88**	**20.80**	**24.44**	**18.74**	**19.63**	**18.23**	**17.84**	**21.02**	**21.05**	**21.16**	**22.26**	**22.10**	**22.00**

Table 2.21 (Continue)

	f20	f21	f22	f23	f24	f25	f26	f27	f28	f29	f30	f31	f32	f33	f34	f35	f36	f37	f38
x1	0.93	0.96	0.95	0.96	0.81	0.94	0.87	0.91	0.91	1.00	0.85	0.92	1.03	0.97	1.02	1.21	5.74	24.15	1.06
x2	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.05	0.03	0.04	0.03	0.04	0.04	0.20	0.83	0.03
x3	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.15	0.60	0.04
x4	0.07	0.12	0.08	0.07	0.05	0.07	0.06	0.06	0.06	0.07	0.06	0.08	0.13	0.08	0.07	0.08	0.35	1.46	0.06
x5	0.55	0.58	0.55	0.54	0.44	0.53	0.48	0.50	0.51	0.56	0.48	0.53	0.99	0.63	0.58	0.66	3.74	14.18	0.53
x6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
x7	0.05	0.17	0.09	0.06	0.04	0.07	0.05	0.05	0.05	0.06	0.05	0.10	0.05	0.05	0.06	0.06	0.29	1.14	0.05
x8	0.16	0.08	0.07	0.07	0.06	0.07	0.07	0.07	0.07	0.08	0.11	0.07	0.08	0.07	0.11	0.09	0.42	1.68	0.07
x9	1.88	1.95	1.93	1.94	1.63	1.89	1.77	1.84	1.85	2.03	1.72	1.86	2.09	1.96	2.07	2.46	11.56	49.70	2.19
x10	0.15	0.16	0.16	0.16	0.13	0.16	0.15	0.15	0.15	0.17	0.14	0.15	0.17	0.16	0.17	0.20	0.98	4.17	0.16
x11	0.13	0.14	0.13	0.13	0.11	0.13	0.12	0.13	0.13	0.14	0.13	0.13	0.14	0.14	0.15	0.17	0.79	3.33	0.14
x12	0.25	0.25	0.25	0.25	0.21	0.25	0.23	0.24	0.24	0.27	0.22	0.24	0.27	0.26	0.27	0.32	1.47	6.30	0.26
x13	0.12	0.13	0.13	0.13	0.11	0.12	0.11	0.12	0.12	0.13	0.11	0.12	0.14	0.13	0.13	0.16	0.75	3.26	0.13
x14	0.09	0.08	0.08	0.08	0.07	0.08	0.07	0.08	0.08	0.09	0.15	0.08	0.09	0.08	0.12	0.10	0.49	2.07	0.08
x15	0.15	0.14	0.14	0.14	0.12	0.14	0.13	0.13	0.13	0.15	0.14	0.15	0.15	0.14	0.15	0.18	0.92	4.00	0.16
x16	0.08	0.09	0.09	0.09	0.07	0.08	0.08	0.08	0.08	0.09	0.08	0.08	0.09	0.09	0.09	0.12	0.57	2.26	0.09
x17	0.70	0.73	0.69	0.68	0.56	0.67	0.60	0.63	0.64	0.71	0.60	0.67	0.76	0.69	0.76	0.86	4.52	18.08	0.67
x18	0.84	0.81	0.82	0.81	0.67	0.83	0.73	0.76	0.80	0.84	0.75	0.76	0.83	0.80	0.87	0.96	3.95	15.91	0.79
x19	0.24	0.24	0.25	0.26	0.21	0.26	0.22	0.23	0.29	0.26	0.25	0.23	0.26	0.25	0.32	0.33	1.49	6.87	0.25
x20	1.75	0.29	0.29	0.28	0.23	0.28	0.25	0.26	0.28	0.29	0.25	0.27	0.29	0.27	0.46	0.35	1.55	6.36	0.28
x21	0.61	2.32	1.10	0.76	0.49	0.91	0.55	0.60	0.66	0.75	0.58	1.26	0.62	0.57	0.74	0.76	3.43	13.65	0.56
x22	0.30	0.30	1.71	0.37	0.25	0.31	0.27	0.29	0.33	0.36	0.28	0.28	0.32	0.29	0.41	0.40	1.75	7.00	0.29
x23	0.62	0.66	0.65	2.12	0.51	0.63	0.56	0.60	0.61	0.72	0.55	0.61	0.66	0.62	0.68	0.80	3.71	15.42	0.61
x24	0.11	0.11	0.11	0.11	1.46	0.11	0.11	0.11	0.11	0.12	0.10	0.11	0.12	0.11	0.12	0.14	0.68	2.94	0.11
x25	0.23	0.24	0.24	0.27	0.20	1.71	0.23	0.27	0.25	0.29	0.20	0.22	0.27	0.23	0.28	0.33	1.38	5.63	0.23
x26	0.24	0.25	0.25	0.25	0.30	0.26	1.77	0.34	0.24	0.29	0.22	0.24	0.27	0.24	0.26	0.32	1.46	6.05	0.25
x27	0.19	0.20	0.20	0.20	0.17	0.20	0.20	1.60	0.19	0.25	0.17	0.19	0.21	0.19	0.21	0.24	1.00	3.97	0.19
x28	0.49	0.51	0.51	0.51	0.42	0.50	0.46	0.48	2.31	0.53	0.45	0.49	0.54	0.51	0.54	1.12	3.19	13.20	0.51

Table 2.21 (Continue)

	f20	f21	f22	f23	f24	f25	f26	f27	f28	f29	f30	f31	f32	f33	f34	f35	f36	f37	f38
x29	0.32	0.34	0.33	0.32	0.28	0.32	0.30	0.31	0.31	1.96	0.29	0.31	0.36	0.32	0.35	0.41	2.01	7.74	0.32
x30	0.20	0.21	0.20	0.20	0.17	0.20	0.19	0.20	0.20	0.21	1.46	0.20	0.22	0.21	0.22	0.26	1.24	5.36	0.21
x31	0.07	0.18	0.12	0.07	0.05	0.08	0.05	0.06	0.06	0.08	0.06	1.58	0.06	0.06	0.07	0.08	0.37	1.43	0.06
x32	1.07	1.12	1.03	0.99	0.81	1.00	0.89	0.92	0.95	1.03	0.87	0.99	3.13	1.28	1.04	1.16	4.89	22.53	0.99
x33	0.04	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	1.35	0.04	0.05	0.19	0.87	0.04
x34	1.30	1.38	1.33	1.33	1.16	1.31	1.23	1.26	1.31	1.37	1.22	1.30	1.46	1.35	2.85	1.64	7.02	28.57	1.38
x35	0.08	0.08	0.08	0.08	0.07	0.08	0.07	0.08	0.08	0.08	0.07	0.08	0.09	0.08	0.09	1.45	0.49	1.92	0.08
x36	0.08	0.08	0.08	0.09	0.07	0.08	0.07	0.08	0.08	0.10	0.07	0.08	0.09	0.08	0.09	0.10	2.45	5.17	0.08
x37	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.07	1.61	0.01
x38	0.22	0.23	0.23	0.23	0.20	0.23	0.21	0.22	0.22	0.24	0.21	0.22	0.25	0.23	0.25	0.28	1.24	5.19	1.54
x39	0.64	0.66	0.64	0.64	0.52	0.63	0.57	0.59	0.60	0.68	0.56	0.62	0.69	0.62	0.68	0.83	7.73	24.65	0.63
x40	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.13	0.51	0.02
x41	0.12	0.12	0.12	0.12	0.10	0.12	0.11	0.12	0.12	0.13	0.11	0.12	0.13	0.12	0.13	0.14	0.61	2.52	0.12
x42	0.42	0.43	0.42	0.41	0.34	0.40	0.36	0.38	0.39	0.43	0.36	0.41	0.43	0.39	0.43	0.61	3.97	13.29	0.39
x43	0.31	0.32	0.32	0.32	0.27	0.31	0.29	0.30	0.30	0.33	0.28	0.30	0.34	0.32	0.33	0.39	1.73	7.58	0.32
x44	0.46	0.48	0.48	0.47	0.39	0.47	0.42	0.44	0.45	0.49	0.41	0.47	0.51	0.47	0.50	0.62	3.06	14.14	0.49
x45	0.10	0.10	0.10	0.10	0.08	0.10	0.09	0.10	0.10	0.11	0.09	0.10	0.11	0.10	0.11	0.13	0.63	2.66	0.10
x46	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.12	0.51	0.02
x47	1.46	1.50	1.51	1.50	1.27	1.47	1.36	1.42	1.43	1.57	1.34	1.44	1.62	1.51	1.60	2.06	9.77	51.69	1.60
x48	0.18	0.18	0.18	0.17	0.14	0.17	0.15	0.16	0.16	0.18	0.15	0.18	0.20	0.18	0.21	0.24	1.46	5.44	0.17
x49	0.19	0.19	0.19	0.19	0.18	0.19	0.19	0.19	0.19	0.20	0.17	0.19	0.21	0.19	0.20	0.24	0.94	3.86	0.19
x50	0.18	0.19	0.18	0.18	0.16	0.18	0.17	0.17	0.18	0.19	0.17	0.18	0.20	0.18	0.19	0.23	1.08	4.41	0.19
x51	0.80	0.83	0.82	0.82	0.69	0.80	0.75	0.79	0.79	0.90	0.72	0.79	0.88	0.84	0.87	1.25	6.41	26.66	0.87
x52	1.32	1.35	1.34	1.38	1.37	1.34	1.35	1.31	1.39	1.23	1.32	1.34	1.33	1.22	1.34	0.83	-4.94	-29.14	1.25
x53	0.38	0.39	0.39	0.40	0.39	0.39	0.39	0.38	0.40	0.37	0.38	0.38	0.39	0.36	0.39	0.28	-0.86	-5.61	0.37
x54	0.66	0.68	0.67	0.69	0.66	0.67	0.67	0.65	0.69	0.64	0.65	0.67	0.68	0.63	0.69	0.51	-1.14	-8.01	0.64
x55	0.06	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.05	0.06	0.06	0.09	0.06	0.06	0.17	0.71	0.06
x56	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.18	0.78	0.03
x57	0.22	0.23	0.22	0.23	0.21	0.22	0.22	0.22	0.22	0.22	0.21	0.22	0.23	0.22	0.23	0.23	0.41	1.06	0.22
x58	0.05	0.05	0.05	0.05	0.04	0.05	0.04	0.05	0.05	0.05	0.04	0.05	0.05	0.05	0.05	0.06	0.26	1.13	0.05
x59	0.07	0.07	0.07	0.07	0.06	0.07	0.06	0.07	0.07	0.07	0.06	0.07	0.07	0.07	0.07	0.09	0.42	1.80	0.07
Sum	**22.05**	**23.15**	**22.83**	**22.55**	**19.19**	**22.31**	**20.58**	**21.19**	**22.06**	**23.37**	**20.16**	**22.33**	**24.58**	**22.19**	**23.85**	**26.82**	**108.67**	**435.27**	**22.28**

Table 2.21 (Continue)

	f39	f40	f41	f42	f43	f44	f45	f46	f47	f48	f49	f50	f51	f52	f53	f54	f55	f56	f57	f58	f59	x	f	x^2	f^2
x1	1.01	1.02	0.97	1.00	0.94	0.96	0.97	0.98	0.97	0.90	0.97	0.98	1.00	1.07	1.05	1.08	0.96	1.03	1.00	0.95	1.06	86.30	1.37	7447.86	1.89
x2	0.04	0.04	0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.03	4.63	1.26	21.44	1.58
x3	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	3.57	1.25	12.77	1.55
x4	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.06	0.07	0.07	0.06	0.06	0.06	0.06	7.04	1.28	49.55	1.65
x5	0.63	0.64	0.62	0.57	0.51	0.51	0.51	0.51	0.54	0.51	0.52	0.53	0.54	0.57	0.55	0.57	0.59	0.54	0.53	0.51	0.52	50.71	1.24	2571.57	1.55
x6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.32	1.29	1.73	1.66
x7	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.05	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	5.69	1.29	32.39	1.67
x8	0.08	0.08	0.07	0.08	0.07	0.07	0.07	0.07	0.08	0.07	0.07	0.07	0.07	0.08	0.07	0.08	0.08	0.07	0.07	0.08	0.07	7.64	1.25	58.39	1.56
x9	2.05	2.05	1.97	2.02	1.90	1.96	1.96	1.99	1.97	1.82	1.98	1.98	2.03	2.17	2.13	2.19	1.95	2.10	2.03	1.87	2.17	172.99	1.49	29925.74	2.21
x10	0.17	0.17	0.16	0.17	0.16	0.16	0.16	0.16	0.16	0.15	0.16	0.16	0.17	0.18	0.18	0.18	0.16	0.17	0.17	0.15	0.18	15.38	1.18	236.51	1.39
x11	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.14	0.14	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.13	0.14	0.14	0.14	0.15	13.25	1.26	175.61	1.60
x12	0.27	0.27	0.26	0.26	0.25	0.25	0.25	0.26	0.25	0.24	0.26	0.26	0.26	0.28	0.27	0.28	0.26	0.27	0.27	0.24	0.28	23.24	1.22	540.00	1.48
x13	0.13	0.13	0.13	0.13	0.12	0.13	0.13	0.13	0.13	0.12	0.13	0.13	0.13	0.14	0.14	0.14	0.13	0.13	0.13	0.12	0.14	12.33	1.19	151.98	1.42
x14	0.09	0.09	0.08	0.09	0.08	0.08	0.08	0.08	0.09	0.08	0.08	0.08	0.08	0.09	0.08	0.09	0.08	0.09	0.08	0.09	0.08	8.72	1.27	76.05	1.62
x15	0.15	0.15	0.14	0.15	0.14	0.14	0.15	0.14	0.15	0.13	0.14	0.14	0.15	0.16	0.15	0.15	0.14	0.17	0.15	0.14	0.15	14.83	1.27	219.79	1.62
x16	0.09	0.09	0.09	0.09	0.09	0.09	0.12	0.10	0.09	0.08	0.09	0.09	0.10	0.10	0.10	0.10	0.09	0.18	0.10	0.08	0.09	9.39	1.27	88.24	1.62
x17	0.84	1.00	0.99	0.78	0.64	0.64	0.66	0.65	0.67	0.64	0.65	0.67	0.69	0.73	0.69	0.72	0.75	0.69	0.68	0.64	0.68	63.59	1.29	4043.55	1.67
x18	0.81	0.80	0.78	0.80	0.75	0.76	0.76	0.76	0.79	0.72	0.77	0.80	0.80	0.84	0.81	1.00	0.80	0.81	0.80	0.78	0.80	66.87	1.35	4471.12	1.81
x19	0.26	0.25	0.24	0.25	0.23	0.23	0.23	0.23	0.26	0.22	0.24	0.24	0.25	0.26	0.24	0.25	0.25	0.25	0.24	0.23	0.24	23.55	1.33	554.52	1.76
x20	0.29	0.30	0.27	0.29	0.26	0.26	0.26	0.26	0.29	0.26	0.26	0.27	0.28	0.29	0.27	0.28	0.29	0.28	0.27	0.26	0.26	24.93	1.32	621.49	1.74
x21	0.60	0.61	0.58	0.59	0.54	0.53	0.53	0.52	0.58	0.54	0.54	0.61	0.57	0.59	0.55	0.57	0.57	0.55	0.55	0.53	0.52	52.92	1.36	2800.09	1.84
x22	0.31	0.31	0.30	0.30	0.28	0.28	0.28	0.27	0.30	0.28	0.28	0.30	0.30	0.31	0.29	0.30	0.30	0.29	0.29	0.28	0.28	26.91	1.35	724.31	1.82
x23	0.65	0.67	0.62	0.63	0.58	0.58	0.58	0.57	0.63	0.58	0.59	0.63	0.62	0.63	0.60	0.62	0.64	0.60	0.60	0.59	0.58	55.37	1.37	3066.36	1.87
x24	0.12	0.12	0.11	0.12	0.11	0.12	0.13	0.12	0.12	0.11	0.16	0.13	0.13	0.12	0.12	0.12	0.11	0.12	0.12	0.11	0.11	11.42	1.26	130.38	1.59
x25	0.25	0.26	0.24	0.25	0.23	0.22	0.22	0.22	0.24	0.22	0.23	0.28	0.24	0.24	0.22	0.23	0.23	0.22	0.23	0.22	0.21	21.69	1.33	470.25	1.78
x26	0.26	0.26	0.25	0.26	0.31	0.25	0.25	0.25	0.26	0.24	0.29	0.32	0.27	0.27	0.25	0.26	0.24	0.25	0.28	0.24	0.25	23.43	1.30	548.97	1.69
x27	0.20	0.20	0.20	0.20	0.19	0.19	0.19	0.18	0.20	0.19	0.20	0.29	0.21	0.20	0.19	0.23	0.19	0.19	0.19	0.18	0.18	17.44	1.30	304.04	1.69
x28	0.56	0.53	0.52	0.54	0.49	0.50	0.50	0.50	0.52	0.49	0.50	0.51	0.52	0.55	0.53	0.54	0.52	0.52	0.51	0.49	0.52	47.20	1.34	2228.16	1.80

Table 2.21 (Continue)

	f39	f40	f41	f42	f43	f44	f45	f46	f47	f48	f49	f50	f51	f52	f53	f54	f55	f56	f57	f58	f59	x	f	x^2	f^2
x29	0.39	0.42	0.43	0.37	0.31	0.31	0.31	0.30	0.34	0.32	0.32	0.39	0.34	0.35	0.31	0.32	0.32	0.32	0.32	0.31	0.30	29.93	1.33	895.83	1.76
x30	0.22	0.21	0.21	0.21	0.20	0.21	0.21	0.21	0.21	0.19	0.21	0.21	0.21	0.22	0.22	0.22	0.21	0.23	0.22	0.21	0.22	19.46	1.27	378.75	1.60
x31	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	6.87	1.32	47.26	1.74
x32	1.08	0.99	0.96	1.00	0.94	0.92	0.93	0.92	1.00	0.90	0.94	0.98	0.97	1.04	1.05	1.07	1.11	1.00	1.00	0.94	0.95	85.15	1.40	7250.45	1.95
x33	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.04	0.04	0.04	0.04	4.65	1.30	21.63	1.68
x34	1.43	1.38	1.35	1.37	1.32	1.30	1.29	1.26	1.45	1.30	1.30	1.33	1.37	1.46	1.33	1.39	1.36	1.31	1.37	1.30	1.23	112.32	1.39	12616.24	1.94
x35	0.10	0.09	0.08	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.08	0.09	0.08	0.08	0.08	8.34	1.26	69.50	1.58
x36	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.08	0.09	0.08	0.08	0.08	0.08	0.08	12.27	1.24	150.49	1.54
x37	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	2.36	1.25	5.56	1.57
x38	0.24	0.24	0.24	0.24	0.23	0.23	0.24	0.24	0.23	0.22	0.24	0.24	0.24	0.27	0.26	0.26	0.23	0.31	0.25	0.22	0.25	20.94	1.31	438.32	1.71
x39	2.05	0.70	0.70	0.82	0.60	0.60	0.61	0.60	0.64	0.60	0.63	0.63	0.65	0.68	0.64	0.66	0.64	0.65	0.63	0.60	0.63	69.90	1.30	4885.47	1.69
x40	0.02	1.32	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	3.04	1.27	9.25	1.61
x41	0.13	0.13	1.48	0.15	0.12	0.12	0.12	0.12	0.12	0.11	0.12	0.12	0.13	0.15	0.13	0.13	0.12	0.14	0.13	0.11	0.13	11.35	1.29	128.71	1.67
x42	0.49	0.54	0.82	1.94	0.38	0.38	0.38	0.38	0.40	0.40	0.39	0.40	0.41	0.46	0.40	0.42	0.40	0.42	0.40	0.37	0.39	42.37	1.31	1794.88	1.72
x43	0.34	0.33	0.33	0.33	1.86	0.34	0.36	0.34	0.32	0.29	0.36	0.32	0.34	0.36	0.34	0.35	0.32	0.36	0.36	0.30	0.34	28.87	1.27	833.42	1.60
x44	0.50	0.50	0.49	0.50	0.45	1.85	0.55	0.59	0.46	0.43	0.47	0.47	0.48	0.50	0.47	0.48	0.46	0.53	0.48	0.44	0.46	45.03	1.29	2027.81	1.67
x45	0.11	0.11	0.11	0.11	0.10	0.10	1.66	0.13	0.10	0.09	0.10	0.10	0.10	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.11	10.58	1.29	111.86	1.66
x46	0.02	0.02	0.02	0.02	0.02	0.04	0.17	1.34	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	3.15	1.29	9.91	1.66
x47	1.70	1.60	1.54	1.61	1.53	1.55	1.60	1.58	2.90	1.41	1.57	1.52	1.60	1.64	1.60	1.63	1.51	1.65	1.59	1.54	1.60	148.32	1.32	21999.04	1.73
x48	0.25	0.38	0.29	0.23	0.17	0.16	0.16	0.16	0.17	1.40	0.17	0.17	0.18	0.18	0.17	0.18	0.20	0.17	0.18	0.17	0.16	18.44	1.21	340.07	1.46
x49	0.20	0.19	0.20	0.20	0.22	0.25	0.23	0.24	0.20	0.18	1.73	0.22	0.21	0.23	0.20	0.21	0.19	0.22	0.20	0.18	0.18	17.41	1.29	303.08	1.66
x50	0.19	0.19	0.18	0.19	0.18	0.18	0.18	0.17	0.20	0.18	0.18	1.53	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.17	17.10	1.30	292.54	1.70
x51	0.86	0.84	0.84	0.86	0.83	0.86	0.93	0.86	0.84	0.76	0.85	0.95	2.29	0.88	0.83	0.85	0.82	0.87	0.90	0.79	0.78	81.19	1.33	6592.34	1.76
x52	1.17	1.11	1.21	1.22	1.21	1.21	1.20	1.18	1.27	1.15	1.19	1.22	1.24	2.67	1.20	1.26	1.21	1.21	1.21	1.18	1.15	39.13	1.39	1530.94	1.94
x53	0.35	0.34	0.36	0.36	0.35	0.36	0.35	0.35	0.37	0.34	0.35	0.36	0.37	0.38	1.73	0.38	0.36	0.37	0.36	0.35	0.35	15.89	1.35	252.64	1.83
x54	0.62	0.59	0.63	0.63	0.62	0.63	0.62	0.61	0.65	0.59	0.62	0.63	0.64	0.67	0.64	2.06	0.63	0.65	0.63	0.61	0.62	28.90	1.39	835.33	1.92
x55	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.05	0.06	0.06	0.06	0.08	0.06	0.07	1.39	0.06	0.07	0.06	0.06	5.60	1.29	31.36	1.66
x56	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	1.36	0.03	0.03	0.03	3.96	1.33	15.68	1.77
x57	0.22	0.21	0.22	0.22	0.21	0.22	0.22	0.22	0.22	0.20	0.22	0.22	0.28	0.24	0.22	0.23	0.22	0.34	1.64	0.21	0.22	15.50	1.32	240.39	1.73
x58	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.06	0.05	1.29	0.05	5.34	1.24	28.55	1.54
x59	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.07	0.07	0.07	0.08	0.08	0.08	0.07	0.07	0.07	0.07	1.43	7.44	1.35	55.38	1.82
Sum	**23.23**	**23.18**	**23.00**	**22.94**	**21.48**	**21.52**	**22.12**	**21.53**	**22.20**	**20.40**	**21.91**	**22.31**	**22.49**	**23.44**	**22.38**	**23.24**	**22.05**	**22.74**	**22.30**	**20.92**	**21.81**	**1793.14**	**76.75**	**125765**	**100**

3 Assessment of Fiscal and Monetary policy responses in Russian Economy: Computable General Equilibrium Analysis

Abstract

The economy of Russia is significantly dependent upon the energy related sectors like oil and gas. The total export share of oil and gas in Russian economy is approximately 58%. In addition, 70% of Russian GDP and 50% of federal revenue depends upon the exports of energy products. Nowadays, oil producing countries are facing the problem of keeping the balance of payment because their export earnings are affected by low oil price. Indeed, fiscal deficit of Russia increased significantly, if we compared first nine months of 2016 with 2015. Overall, the Russian GDP contracted by 3.4% due to fall in the prices of oil. There are two main objectives of the current study; first to analyze the fiscal policy with the injection of investment on the income generation of Russian economy by using Static Computable General Equilibrium model and further to quantify the variation in macroeconomic variables like GDP, Gross value added (GVA) and compensation of employees (CE) by commodities, with the aim of supplying solid energy policy recommendations for Russia. The second objective of study is to access the appropriate monetary policy responses for Russian economy due to oil price shock by using dynamic Computable General Equilibrium. For this purpose, the current study has constructed the Financial Social Accounting Matrix (FSAM) for the Russian economy for 2015, which is still missing in the existing studies. The FSAM stands for the integration between real and financial side of economy and depicts the interaction between production, income generation, distribution and use, capital accumulation and financial accounts. More specifically, the FSAM for Russia provides a disaggregation of 59 Industries, derived from the Supply and Use Tables and National Accounts from Russian Federal State Statistics Services (ROSSTAT). The main purpose of building the Russian FSAM is to develop the Computable General Equilibrium (CGE) model to assess the oil price shocks and monetary policy and to check the direct and indirect impact of policies oriented to oil and gas related industries.

Keywords: Russia; Financial Social Accounting Matrix; Fiscal Policy, Monetary Policy, Computable General Equilibrium

JEL classification: C68, E16, O13, P28, P48, Q43

3.1 INTRODUCTION

Historically, Russian economy faced a huge shock due to collapse of the Soviet Union, Gross Domestic Product (GDP) fell from US $516 billion in 1990 to US $196 billion in 1999, which represents the 60% downfall of total GDP. As per recommendations of International Monetary Fund (IMF), in the era of 1990s Soviet Government privatized many Russian industries except of energy and defense sectors. In 1998, Russian ruble faced huge depreciation (known as Ruble crises) but after this Russian economy boosted due to upward trend of oil prices from 1999 to 2008. This upward trend in oil prices was a big support to Russian economy, which has heavily reliance on energy sector and was growing at an annual average rate of 7%. With the passage of time, Russia's economy began to grow rapidly and increased 4.5%, 4.3% and 3.4% in 2010, 2011 and 2012, respectively, before the recent year's downfall to 1.3% in 2013 and 0.6% in 2014.

Russian economy has faced numerous challenges in 2014 and 2015 including deficient of balance of payment, depreciation of domestic currency (ruble), inflation, capital flight, etc. Moreover, the economic condition of Russia faced more challenges due to U.S and EU economic sanctions and low price of oil, as oil and gas are major export of Russian economy. In November 2014, Russian Finance Minister estimated that annual loss of economy is due to economic sanctions to the Russian economy is $40 billion (2% of GDP), compared to $90 billion to $100 billion (4% to 5% of GDP) lost due to lower oil prices. The importance of energy related goods especially the export of oil is that Russian economists estimated that the financial sanctions would decrease Russia's GDP by 2.4% by 2017, which would be 3.3 times lower than the effect from the oil price shock.

Russia's current accounts reported record level of trade surplus due to huge exports of oil and gas. From year 2010 to 2014, Russian average current account surplus increased and reached at the peak level in 2011 at USD 98.8 billion. The private capital outflow has increased from USD 60.7 billion in 2013 to USD 130.5 billion in 2014. During the same period capital and financial accounts of the Russian Federation fell from a deficit of USD 45.4 billion to a deficit of USD 146 billion (2.2% and 7.8% of GDP, respectively). On the other hand, Russian economy faced two severe shocks during 2014 and in the results of these shocks Russian economy turned into huge recession with growth rate of 0.6%. The first shock was a sharp decline of oil prices during third and fourth quarter of year 2014.The second shock was the imposition of economic sanctions by U.S and EU, which further negatively affected the FDI of Russia.

The Russian economy contracted 3.7% during the full year of 2015. The major part of Russian economy is based on the export of crude oil, petroleum products and natural gas and 58% of total exports on energy related products (crude oil, petroleum products and natural gas), 4% export is based on iron and steel and 2.5% exports consists of other mining sector related exports including gems and precious metals account for about 2.5%.Russia has exported 60%, 30% sales to Europe and Asia respectively and less than 5% exports to the United States, Africa, and Latin America.

Economists highlighted many economic challenges of Russian economy including reliance on the exports of energy related products (oil and gas), as well as to address the number of areas, including governance, corruption, regulation, privatization, competition, the banking sector, etc. There are many studies on the natural gas. Some researchers investigated the distributions, e.g., (Erdogdu, 2010) for Turkey, (Fiorini & Sileo, 2013) for Italy, (Goncharuk, 2013) for Ukraine and (Khatib, 2014) for MENA regions. Some studies investigation the price affecting determinants of natural gas like (Arano & Velikova, 2012; Slabá et al., 2013). On the other hand, some studies have measured the efficiency of natural gas (Erbetta & Rappuoli, 2008; Goncharuk, 2008; Sadjadi et al., 2011).

There is almost Russian monopoly in the European gas market so that's why the Russian government has planned to increase the domestic gas price in the long term[21]. Russia is one of the largest producers and exporter of natural gas and similarly Russia has second largest proven reserved of natural gas globally[22]. The Gazprom is one of the largest natural gas producers in Russia and has monopoly on the production of gas, whose share accounted for 71.3% of total gas production in 2013 (See, Ministry of Energy of the Russian Federation). Russia is the biggest natural gas supplier to its domestic market, the European market, and the Commonwealth of Independent States (CIS's). One interesting fact is that Russia is not only the largest producer of gas, but it is also the biggest domestically consumer of natural gas. In the domestic market the 70% supply of natural gas is consisted of the domestic consumption of natural gas in 2012 (See, International Energy Agency; 2014).

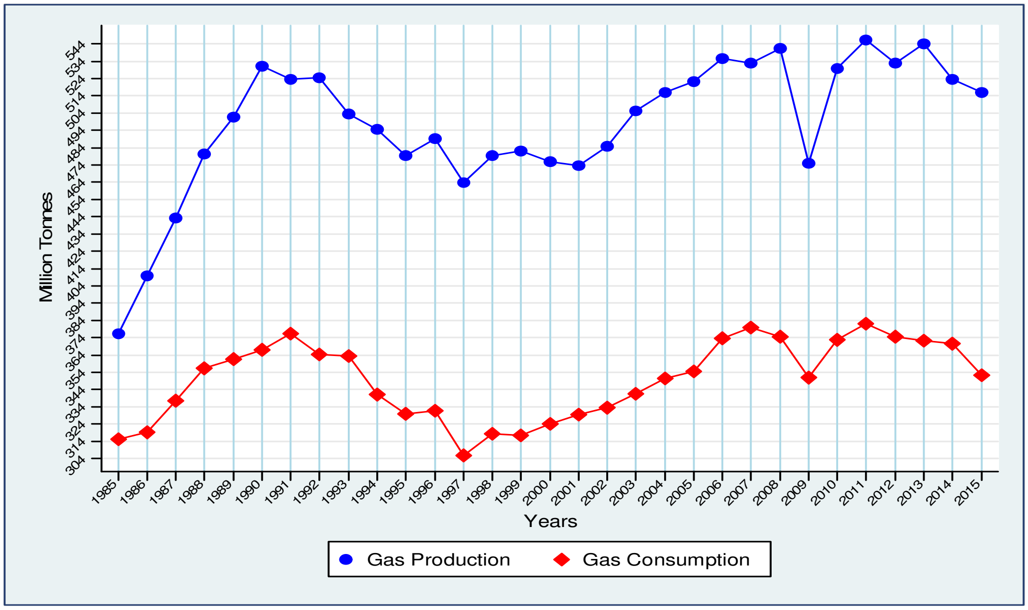
The facts and figure of oil production and consumption for Russia has been explained in Chapter 2 (Subsection 2.2.1). The figure 3.1 below shows that both

[21]http://base.consultant.ru/cons/cgi/online.cgi?req=doc;base=LAW;n=162054;fld=134;dst=4294967295;rnd=0.1672593537024063;from=110851-6

[22]http://www.eia.gov/countries/cab.cfm?fips=RS

production and consumption of gas has been increasing from year 1985 to 2015. The graph indicated that a big shock has been observed between 2008 to 2011 in the gas production and consumption, which may be due to change in the dynamics of European Union economics due to financial crises).

Figure 3. 1 Gas Production and Consumption of Russia, Million Tonnes oil equivalent



Note: Data for Gas production and consumption taken from BP Statistical Review of World Energy (2016)

Generally, there are two channels like export channel and fiscal channel are working in oil exporting countries. The export channel is working as; whenever the oil price increase, then oil exporting country earns more capital flow in the form of foreign currency, which further leads the domestic currency rate appreciate. However, there are two impacts of domestic currency appreciation decreases the imports prices, which is usually heavily affect the energy export country due to heavily dependence of consumer goods on the foreign countries. Therefore, there is negative relationship between oil price increase and decline in the general prices (deflation) in oil exporting country and further due to monetary policy reaction, the interest rate declines as well (according to the Taylor rule). The second channel is the fiscal, which is working as; due to oil export increase also stimulate the taxes collection on energy export, which leads to increase in revenue (fiscal surplus) in simple words there is directly proportional relationship between the oil prices increase in energy exporting country and fiscal surplus, which also further stimulate the government spending, which eventually lead to an increase in GDP. (See, Alekhina & Yoshino,2018).

There are two main objectives of current studies by using the Fiscal as well as monetary policy by assuming the scenario of low oil prices. The aim is to adjust the appropriate fiscal as well monetary policy to pull down the oil exporting economy from low growth phase to the phase, where oil-oriented economy can achieve the sustainable economic growth. In case of low oil prices for oil exporting country like Russia, low oil export is a cause of low taxes collection on energy products export, which eventually leads the low Government revenue (fiscal deficit), which further slowdown the government spending, which eventually lead to a decrease in GDP. For this purpose, there will be needs to stimulate the Government spending by injecting public investment in the oil exporting country. So, for this purpose, the first objective is to analyze the expansionary fiscal policy with the injection of public investment on the income generation of Russian economy by using Static Computable General Equilibrium model and furtherly to quantify the variation in macroeconomic variables like GDP, GVA and CE by commodities. Similarly, whenever the oil price decreases, then oil exporting country earns less capital flow in the form of foreign currency, which further leads the domestic currency rate depreciate. However, due to domestic currency depreciation, imports prices increase, which creates inflation due to import of consumer goods from the foreign countries. Therefore, there is negative relationship between oil price decrease and increase in the general prices (inflation) in oil exporting country and further due to monetary policy reaction, the interest rate increases as well (according to the Taylor rule). However, oil exporting economy trapped in high interest rate, so for this purpose there is need to inject the supply of money, which will further decrease the level of interest rate and will lead to increase the investment, aggregate demand and production level in the oil exporting country. The second objective of the study is to analyze the monetary policy responses with the injection of supply of money in Russian economy by using Dynamic Computable General Equilibrium. The main aim of above said objectives is supplying solid economic policy recommendations for Russia. The real SAM has no any ability to capture the financial side (monetary side) effect of economy, so for this purpose the current study is developed the FSAM to capture the real as well as financial side of economy. The current CGE is depicting the real as well financial flows with assets, liabilities and monetary aggregate, etc.

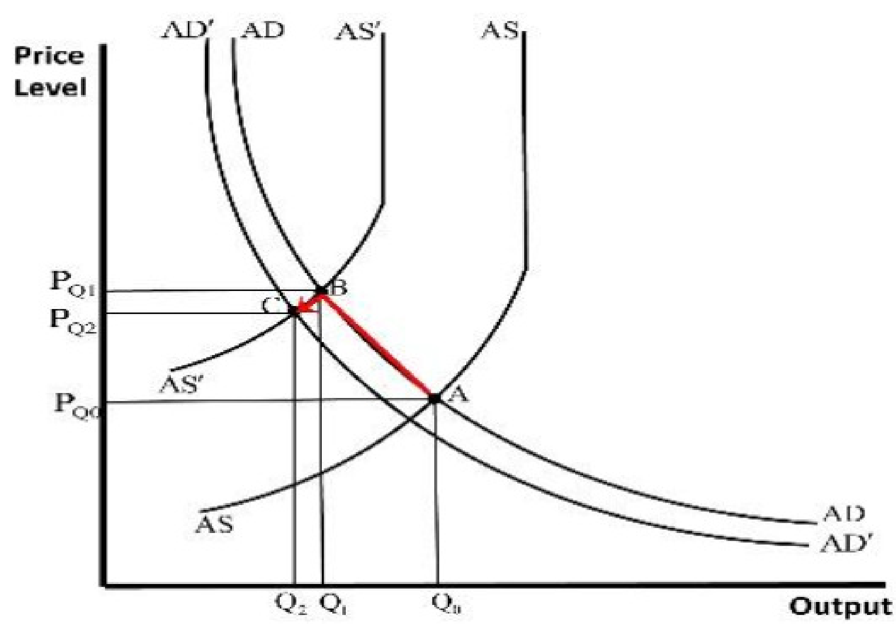
The section 3.2 explains the macroeconomic dynamics of oil price shocks. Section 3.3 provides a detailed Literature review. Subsection 3.3.1 explains the different approaches of CGE Modelling. Subsection 3.3.2 represents the Computable General

Equilibrium Model. Subsection 3.3.3 represents the advantages of CGE models. Subsection 3.3.4 represents the disadvantages of CGE models. Subsection 3.3.5 represents the fundamental relationship for CGE modelling. Subsection 3.3.6 represents the Estimation procedure of Computable General Equilibrium Modelling. Subsection 3.4.1 represents the methodology of Static Computable General Equilibrium Model. Subsection 3.4.2 represents the empirical analysis of Static Computable General Equilibrium Model. Subsection 3.4.3 represents the methodology of Dynamic Computable General Equilibrium Model. Subsection 3.4.4 represents the Empirical analysis of Dynamic Computable General Equilibrium Model and last section concludes the paper.

3.2 MACROECONOMIC DYNAMICS OF OIL PRICE SHOCKS

Generally, according to theoretical point of view for Energy economics dynamics, the oil prices are considered as engine of economic growth for oil exporting countries. As, the oil prices are crucial because the oil is not only used in energy related products but also used in transportation as well as input among labour and capital to produce intermediate goods.

Figure 3. 2 Aggregate Demand and Supply Mechanism in Oil Market



Source: Yoshino & Taghizadeh-Hesary (2015)

There is strong relationship between energy prices and (inflation and economic growth). The figure 3.2 depicts the oil price, aggregate demand, and aggregate supply mechanism. The above energy market mechanism described for Japanese economy by the studies of (Taghizadeh-Hesary & Yoshino, 2013 & 2014) and (Yoshino & Taghizadeh-Hesary, 2015). In the above figure 3.2, the initial equilibrium level is at point A, here AD=AS and equilibriums price and quantity are P_{Q0} and Q_0 respectively. Therefore, by assuming that if the oil price increases its also stimulate the price of other energy products and production becomes expensive and aggregate supply decreases and AS curve shifted leftward from AS to AS′. The price rises from P_{Q0} to P_{Q1} and output decrease from $Q_0$to Q_1, due to this new shifting the oil market becomes at disequilibrium point B. The higher prices P_{Q1} further decrease the aggregate demand and AD curve shifted leftward from AD to AD′ and economy moves at new equilibrium point C with decreases the prices from P_{Q1} to P_{Q2} as well as output from Q_1 to Q_2.

3.3 LITERATURE REVIEW

There is large plethora of studies has been done on the different energy and natural resource related issues. The current study divided the energy related issues into two parts, the first part is consisted on the issues depended upon the different techniques (it is a general view of energy literature), the second part is consisted on the review and methodological characteristics of CGE models.

3.3.1 Different Approaches of CGE Modelling

The bottom-up models are partials models in nature and capability to incorporate the different economic activities like CO_2 and SO_2 emissions. The earlier studies classified the bottom-up models into different methodological groups. For example, the study of (Hourcade et al., 1996) classified the bottom (BU) models into optimization models or spread sheet models and simulation. On the other hand, the study of (Herbst et al., 2012) classified the BU models into four groups, which are consisted on partial equilibrium, optimization, simulation, and multi-agent models. Similarly, the study of (Grandjean et al., 2012) subdivides the BU models into statistical random, probabilistic empirical and time of use-based models. According to the study of (Proença & Aubyn, 2009), the bottom-up models are based on the partial equilibrium and engineering oriented in their nature. The bottom-up models follow the disaggregation levels, so there is requirement of large data sets and information to find out the results, (Kavgic et al., 2010); (Böhringer & Rutherford, 2009) mentioned in their findings that the bottom-up (supply oriented) energy models can be solved by applying the quadratic programming.

The bottom-up models can be classified into further two estimation groups, the first estimation technique is the optimization, where usually researcher used some objective functions, e.g., (i) to minimize the cost of energy demand; (ii) to increase the utility of consumers with the help of some subjective function like technological factors. On the other hand, the second one is simulation method, which is usually based on some statistical properties. We are explaining the both techniques in more detail.

The bottom-up simulation models are based on some statistical properties and dynamics in nature and have a capability to integrate the energy, environmental and other natural resource-based models, e.g., (NEMS and POLES). The study of (Kavgic et al., 2010) mentioned some advantages of bottom-up approach, (i) no detail description required for the technological factors, (ii) capacity to interact the energy sectors with the other sectors of the economy, (iii) ability of modelling between the energy demand and other economic variables, (iv) Follow the aggregate level of data sets. Similarly, the study also mentioned some limitations of bottom-up models, (i) there is requirement of past information of energy role in the economy and then future projection is possible. (ii) there is low level of information about the technology role in the economy. (iii) Less efficient in the technological oriented issues (iv) Follow the models without efficient gaps but if the markets are efficient.

The top-down (TD) models are based on the disaggregation type analysis on the national or regional level (Dixon & Adams, 1995). The most prominent studies on the top-down models are ORANI type models, e.g., (Dixon et al., 1982); (Horridge et al., 1995) and similarly MONASH-RES models like (Dixon et al., 1998); (Haddad & Azzoni, 1999); (Parmenter & Welsh, 2001), and (Haddad & Domingues, 2003). There are some complexities in TD models like the BU models. The study of (Swan and Ugursal, 2009) classified the TD models into econometric model based on price, income, and technological factors. Therefore, the study of (Lee & Yao, 2013) adopted the classification of (Swan and Ugursal, 2009) in such a way to focus on sector specific and whole economy models. On the other hand, the study of (Hourcade et al., 1996) subdivides the models into neo-Keynesian macroeconomic models and estimated CGE model based on estimating the long-term growth paths by using the simulation. The study of (Grandjean et al., 2012) subdivides TD models into deterministic statistical disaggregation models. (Herbst et al., 2012) classifies the TD models into four groups like input-output; econometric; CGE and system dynamics (SD) models.

The top-down model incorporates the several factors of the economy as an endogenous, so, due to this drawback TD models are not suitable for the energy models because it ignores the exogenous factors like technology. The TD models are mostly used with E3 computable general equilibrium models, which are based on the (Arrow & Debreu., 1954) Walrasian model. The study of (Kavgic et al., 2010) mentioned some advantages of top-down approach, (i) Have a capacity to absorb the macro level factors in the economy and also interact with the other socioeconomic factors, (ii) Ability to determinate the typical energy consumption, (iii) Have capacity to easy adoption and also application, (iv) Applicable by using the little data and does not require any huge level of survey for technical variables. On the other hand, the study also mentioned some limitations of top-down models, (i) Models are rigid in the sense that not following the big data sets, (ii) Low capacity to measure the energy conservation issues, (iii) More dependent on the historical information about the energy consumption data sets, (iv) Ignoring the large sample of data sets (v) Chance of correlation between the independent variables (Multicollinearity).

The hybrid models are the amalgam of both bottom-up and top-down models. Both the bottom-up and top-down models have some deficiencies and researchers could not rely completely on any single models that is why the researchers felt that there is need to see the energy and resource-based issues with the mixture of both top-down and bottom-up models (Hybrid models). The study of (Proença & Aubyn, 2009), mentioned three types of Hybrid models, (i) First one is based on the interaction of input and output of both top-down and bottom-up models, (ii) Second one is linked in such a way that one model is actually the reduced form of others and usually the bottom-up models are deriving in the form of CGE models, (iii) Third is the most comprehensive form of Hybrid model, which represents the Mixed Complementarity Problem (MCP), it's an interaction of both bottom-up and top-down models (Rutherford, 1995); (Dirkse & Ferris, 1995); (Wene, 1996); (Böhringer, 1998); (Bahn et al., 1999); (Messner & Schrattenholzer, 2000); (Böhringer et al., 2003); (Frei et al., 2003); (Kumbaroğlu & Madiener, 2003); (McFarland et al., 2004); (Bosetti et al., 2006); (Böhringer & Loschel, 2006); (Hourcade et al., 2006); (Schumacher & Sands, 2007); (Böhringer & Rutherford, 2008); (Strachan & Kannan, 2008); (Turton, 2008); (Böhringer & Rutherford, 2009); (Labandeira et al., 2009) and (Tuladhar et al., 2009).

The detail historical view of those energy related studies that used bottom-up, top-down and Hybrid models are given in the following table 3.1.

Table 3. 1 Summary of previous for Top-Down, Bottom-Up and Hybrid Energy Models

S. NO.	COUNTRY	TOP-DOWN MODELS	BOTTOM-UP MODELS	HYBRID MODELS
1	Canada	Integrated total energy demand model (Arsenault et al. 1995)	CREEM- Canadian Residential Energy End-use Model (Farahbakhsh et al., 1998) CREEEM - Canadian Residential Energy End-use and Emission Model (Fung et al., 2000) Nova Scotia residential energy model (MacGregor et al., 1993)	CHREM- Canadian Hybrid Residential End-use Energy and Emission Model (Swan et al., 2008) CIMS- Canadian Integrated Modelling Systems hybrid model (Rivers & Jaccard, 2006)
2	USA	NEMS-National Energy Modelling System (Energy Information Administration 2005) ORNL- Oak Ridge National Laboratory model (O'Neal & Hirst, 1980)	PRISM- Princeton Scorekeeping Method (Fels, 1986) CDA- Conditional demand analysis model (Parti & Parti,1980); (Aigner et al.,1984) Bottom up engineering model (Huang & Brodrick, 2000)	SAE-Statistical Adjusted Engineering model (Train et al., 1985) USMM-US MARKAL-Macro (Morris et al., 2002)
3	Brazil	--	CDA-Conditional demand analysis (Lins et al., 2002) NN- Neural networks (Neto & Fiorelli, 2008)	--
4	UK	ADEPT- Annual Delivered Energy Price and Temperature (Summerfield et al., 2010) MDM-E3 - Multi-Sectoral Dynamic Energy-Environment-Economy Model (Barker et al. 2007)	DECM- Domestic Energy and Carbon Model (Cheng and Steemers, 2011) UKDCM- UK Carbon Domestic Model (Boardman et al.,2005) Scottish Domestic Energy Model (Clarke et al., 2008) SMLP- Simple Method of formulating Load Profile (Yao & Steemers, 2005)	UK-M-M -UK MARKAL-Macro (Strachan & Kannan, 2008)
5	Sweden	(Tornberg & Thuvander, 2005)	High resolution stochastic model (Widén & Wäckelgård, 2010) High resolution energy demand model (Richardson et al., 2010) TOU-Time of use data model (Widén et al., 2009)	--
6	Italy	EDM -Energy Demand Model (Gori & Takanen, 2004) Long-term consumption forecasting model (Bianco et al., 2009)	ARGOS (Capasso et al., 1994) Neural Networks (Beccali et al., 2004)	Italy- M-M- Italy MARKAL-Macro (Contaldi et al. 2007)

7	Switzerland	(Siller et al., 2007) IO-Input-output model (Nathani et al., 2006)	Eta model (Bauer & Scartezzini, 1998) Generalised stochastic model (Page et al., 2008)	CGEM-ETEM- Computable general equilibrium Model-Energy technology environment model (Drouet et al. 2005) SCREEN- Sustainability Criteria for Regional Energy policies (Kumbaroğlu & Madlener, 2001)
8	China	(Zhang, 2004) • Econometric model (Yang & Yu, 2004)	EM-Engineering Model (Chen et al., 2008) SM- Statistical Model- (Ma et al., 2010)	M-M- MARKAL-Macro model (Chen et al., 2007)
9	Japan	Econometric model (Hunt & Ninomiya, 2005)	Residential end-use energy simulation model (Shimoda et al., 2004) Residential end-use demand model (Nishio & Asano, 2006)	AIM- Asian-Pacific Integrated Model (Kainuma et al., 2000)
10	New South Wales	--	Physics based bottom up model (Ren et al., 2012) DELMOD (Bartels et al., 1992)	Combined ε-SVR model (Wang et al., 2009)
11	South Africa	--	SM- Statistical model ARIMAX (Hoffman, 1998) MARKAL/TIME optimization tool used for a non-electrified rural village (Howells et al., 2005)	--

3.3.2 Computable General Equilibrium Model

The famous marginalist economist (neoclassical economists) like (Gossen, 1854); (Jevons, 1871) and (Walras, 1874) are main pioneer of "General Equilibrium Theory" in the field of economics but the most influential work has been done by the famous French "Mathematical Economist", (Leon Walras, 1834-1910). The study of (Johansen, 1960), firstly introduces the Computable general equilibrium (CGE). After the work of Johansen, a large plethora of study has done research by using the CGE, but the most prominent studies are like e.g., (Shoven & Whalley, 1972); (Whalley, 1975 & 1977); (Shoven, 1976); (Miller & Spencer, 1977); (Devarajan et al., 1986); (Decaluwe et al., 1996).

There are many studies which have applied CGE modelling on different economics and social issues. The important studies of CGE on energy and environmental issues are like e.g., (Capros & Ladoux, 1985); (Conrad & Henseler-Unger,1987); (Bergman, 1988 & 1991); (Van der Mensbrugghe, 1994); (Bhattacharyya, 1996); (Saunders, 2000 & 2008); (Sorrell, 2007); (Dimitropoulos, 2007); (Turner, 2009); (Lecca et al., 2011). In the era of 90s, the new trend to explore the environmental and resource economics has been started, especially related with the Kyoto protocol (Bergman, 2005). Most of studies used the famous four versions of CGE by adopting the approaches like (i) Classical (ii) Johansen (iii) Kaldorian and (iv) Keynesian but the Neo-classical is most frequently used version.

The study of (Hosoe, 2000) analyzed the Structuralist CGE which is equipped with the constant wage rate and unemployment, which depicts the unlimited supply of labor. The most severe problem in the measurement of CGE is the assumption of fixed prices. The researcher should take care in the choice of numeraire, when the price has been fixed in CGE modelling. The Neoclassical CGE model is based on the famous Walrasian model, so the Structuralist models are Neoclassical in the nature. We should take care about the zero homogeneity of prices, if the zero homogeneity of prices is existing then we can choose any value as a numeraire to fix the price. If the non-zero homogeneity will be existing, it means there will be chance of inappropriate simulation results in qualitatively as well as quantitatively.

The real CGE model has not any ability to interlink the real and financial variables, therefore the researchers developed FCGE for the proper integration of real and financial variables. However, due to dynamic characteristics, Financial CGE models are emerging till today and many studies used FCGE, e.g., (Easterly, 1990) and (Rosensweig & Taylor, 1990) focused on currency devaluation and international balance of funds; (Bourguignon et al., 1991) investigated the income distribution effects; (Lewis, 1992) and (Yeldan, 1997) estimated the impacts of financial liberalization reforms; (Naastepad, 2001 & 2002) studied macroeconomic effects of directed credit policies and stabilization policies for India; (Xiao & Wittwer, 2009) examined effects of RMB appreciation on China's current account surplus; (Simorangkir & Adamanti, 2012) explored real-financial linkage on Indonesian Economy during financial crisis; (Manzoor & Abed, 2013) conducted a research on interest rate change effects on household welfare; (Dixon et al., 2014) estimated a FCGE model for Papua New Guinea. At the macro-level, the sudden change in oil price has significant effect on macroeconomic variables such as exchange rate, interest rate, and inflation and could fluctuated by the current account and balance and net foreign assets position, leading to a recession or economic growth (Pant et al., 2010).

The nature of transmission channels of oil price shock for oil importing and oil exporting countries is different. The first channel for oil exporting countries is that the oil price shock could affect the government revenue and expenditure. In the literature, very few studies are available about oil exporting countries (Eltony & Al-Awadi, 2001) on Kuwait; (Olomola & Adejumo, 2006) on Nigeria; (Berument et al., 2010) on sample of countries in MENA, and (Esfahani et al., 2013) on Iran. Similarly, the studies like (Anciaes et al., 2012); (Moshiri & Banihashem, 2012) found asymmetric effects due to high oil prices for oil exporting developing countries. General perception in literature is that if the oil exporting countries faced stagnate economic growth due to low oil price or economic growth does not sustain due to high oil prices, that situation is called pro-cyclical nature of fiscal policy. Due to low oil price, oil exporting could trap in stagnate economic growth, (Sturm et al.,2009 and Anciaes, 2012). Most of the available studies in literature have been investigated on oil price shocks and monetary policy by using Econometrics techniques. There are very few studies on CGE that investigated the linkage between Oil price shock and financial variables, e.g., supply of money, exchange rate and inflation, etc. (Sánchez, 2011) analyzed dynamic CGE model and estimated that due to rise in oil price, GDP losses 2% to 3% annually have been noted in six oil importing countries (Bangladesh, El Salvador, Kenya, Nicaragua, Tanzania, and Thailand).

At the micro-level, researchers have been investigated three channels between the sudden oil price fluctuation and macroeconomic variables. First, includes the endowment effect (which reflects changes in the quantum of resources available to the individual). Second, price effect (reflecting changes in the reward of the resource endowments) and third, occupational effects (which are linked to changes in resource allocation), (Essama-Nssah, et al., 2007). Similarly, studies of (DeLong, 1997); (Clarida et al., 2000); (Barsky & Killian, 2001); (Hooker, 2002) and (Barrell & Pomerantz, 2008) emphasized on the role of monetary policy response of central banks for the consequences of an oil price shock for inflation and output level.

For oil exporting countries, due to oil price shock the wealth would be increased, household expenditure will increase, which will cause decrease in savings and ultimately interest rate will be increased (Dohner, 1981); (Cologni & Manera, 2008) and (Abel et al., 2014).On the other hand, studies about the impact of oil price shock on the different economic variables for oil importing countries are also available, e.g.,(Ahmed & O'Donoghue, 2008) calibrated CGE model for Pakistan and found that a10% increase in the import price of petroleum brings about a 0.7%and 4.3% decline in GDP and private consumption respectively.(Chitiga et al., 2010) estimated the impact of oil price on the economy of South Africa by using an energy-oriented Macro–Micro CGE model. The study investigated two different scenarios of oil price rise and its impact on macroeconomic variables and found that GDP would fall between 2.2% and 2.5%. In the first scenario, study found that the impact of rise in oil and petroleum products prices is fully transmitted to end users (floating price scenario). On the other hand, the second scenario assumes full compensation of the welfare loss by implying subsidy (fixed price scenario).

The study of (Doroodian & Boyd, 2003) investigated the effect of rising oil prices on US economy by constructing a dynamic CGE model by considering various assumptions of exogenous technological change. The study found that due to service-oriented economy, US shifts away from manufacturing, which further protects the US economy from oil price shock because of low input (oil) price for production process.

The policy makers stroked too much concerned on oil price shocks because of heavily dependence of economies. Oil price shocks are crucial for economies because it raised the input prices as well as consumer goods prices (gasoline and heating oil) which would further increase the inflation and decrease the output level (GDP). There are two spheres of possible monetary policy responses, if monetary policy makers try to tackle the recession effects of oil price shocks and try to stabilize the output level by adopting expansionary monetary policy, it would obviously create the high inflation in the economy. On the other hand, if monetary policy makers focus entirely on neutralizing the impact of inflationary pressure by adopting the contractionary monetary policy, it would be decreasing the level of output in the economy. Therefore, policymakers challenged trade-off between stabilizing the inflation and output level, (Montoro, 2012).

There are many unique advantages of Computable general equilibrium models on the other traditional methodologies. There are some most prominent advantages of CGE is given below and these advantages mentioned by the study of (Borges,1986).

3.3.3 Advantages of Computable General Equilibrium (CGE) Models

First, the most important strength of CGE model is that the CGE model has very strong microeconomic foundation. CGE models have ability to integrate the different economic agents (consumers, producers, etc.). Second, the CGE models have a capacity of internal consistency, the complex interrelationships can be solved by simulation and supply the surprising results. Third, the CGE models have the advantage of disaggregation of the economy, meaning that CGE models have capacity to explain the economy in more detail. Fourth, CGE models supply the strong analytical base and ability to measure the impact of different economic factors, its size and causes. On the hand the other models have no such capacity to provide this type of dynamic settings. Fifth, CGE models supply the flexible framework of algorithm solution and due to this flexibility, modeler can develop more disaggregated level of models. Sixth, this class of model specifies the economy in great details thus incorporating many structural aspects that corresponds to market distortions or failures for example taxes. The distortions affect the economy differently and the solutions are not clear cut. CGE models can effectively detect and analyze the distortions with some depth. Seventh, CGE models have capacity to solve the problem in numerically as well as analytically terms by estimating the results in smaller and broader framework. CGE models have ability to measure the important economic factors by incorporating (i.e., the introduction of modern technology, impact of tariff, natural resources, massive structural changes, and imposition of new taxes, etc.).

3.3.4 Disadvantages of Computable General Equilibrium (CGE) Models

As we have seen the advantages of CGE, similarly on the other hand there are some disadvantages or limitations of CGE. We will try to mention the disadvantages point wise. The disadvantages from (i) to (iii) mentioned by the study of Carri (2008) and study of (Iqbal & Siddiqui, 2001) has mentioned some important disadvantages of CGE models, which are described in points (iv) to (viii):

First, the assumption of CGE models are very weak and unrealistic, as CGE is based on CRS and perfectly competitive markets. Second, CGE models ignores the role of money but due to this criticism, in the latest version of CGE researchers incorporated the assets markets. Third, Lack of data in developing countries is another issue to apply the CGE models for economic analysis, (Mansur et al., 1984). Fourth, the CGE models faces the problem in choice of proper functional form of models, mostly using the constant elasticity of substitution (CES), which bounded under the strict assumptions about the industries structure during the modelling, by applying a same level of non-negative CES on all pairs of goods in the aggregator. After these limitations, the recent studies like (McKitrick, 1998) and (Perroni & Rutherford, 1998) adopted the more flexible functional forms, by applying the translog or normalized quadratic, which are more flexible impact on the parameters in aggregation. Fifth, the CGE models are overly sensitive in the matter of choice of proper parameters. The usual practice in the choice of parameters in the CGE modelling is that, the choice of some parameters has been chosen based on survey of empirical literature, some are selected arbitrarily, and similarly some are based on the replication procedure by adopting the benchmark year of data sets. Sixth, the earlier studies like (Lau, 1984); (Hansen & Heckman, 1996), and (Partridge & Rickman, 1998) mentioned some issues related with the calibration of the model. These studies argued that the reliance on the benchmark year is not proper and not represent the structure of the economy in the normal shape because due to adoption of benchmark year in calibration process, the system is undergone the under identified. On the other hand, the study of (Mansur et al., 1984) suggested that by espousing the average benchmark years, the investigators can take over the possible issues of calibration of models. Seventh, the basic CGE models developed on the static nature, which just focused on the one-time dimension and inappropriate to do the dynamic analysis with respect to different time dimensions. But the later, researchers introduced the dynamic Computable General Equilibrium (DCGE) models to overcome the limitations of static CGE models. The DCGE models can work w.r.t time and ability to do the forecasting of different economic analysis. The most crucial factor in the DCGE models is to check the behavior of household. By using the DCGE models, the researchers can find out the different equilibria and then construct a time path. Eight, the sensitivity of results in CGE modelling is also sensitive, researchers just focus on the minor changes of the elasticities and rely on the estimated results.

3.3.5 Fundamental Relationship for CGE modelling

The fundamental relationship for CGE modelling structure has described in table 3.2, as we know there are different types of markets, but the current SCGE model is based on the assumption of perfect competitiveness[23]in commodity and primary factors markets. By assuming m markets, where n is denoting the number of commodities (59 by 59), f represents primary factors (including compensation of employees, gross operating surplus plus mixed income, other taxes less subsidies on production), and h utility functions and budget constraints from h institutional sectors with the equilibrium condition on balance saving and investment.

The market clearing condition for all commodities is fulfilling the condition where the total supply must equals intermediate demands $B(x,p)$,final consumption expenditures for household $C(rd,p)$, government expenditures $G(rd,p)$, exports $E(x,e)$ and capital formation $I(p)$.The domestic production function is Leontief in nature and based on CES[24] assumption. Therefore, domestic output is also representing the intermediate demands (B) and value added (Y). The consumption expenditure of households and government is depending upon the disposable income (income after deduction of taxes and social security) 'rd' and price 'p'.The institutional sectors can achieve the maximum level of utility, which is depending upon the (C and G) and gross savings (S_h and S_g) subject to their budget constraint.

The production process generates income generation among the institutional sectors (R_i) and income disaggregated in the phase of primary income distribution. The second income distribution refers to transfers of taxes among the institutional sectors (T_{ri} and T_{ai}) and further attaining the formation of disposable income. The disposable income can be allocated between the final consumption ($C_i$and G) and savings (S_i).The single period equilibrium requires that total gross fixed capital formation (I) becomes equal to gross savings by Institutional Sectors ($S^h(rd)$, $S^g(rd)$ and $S^{row}(rd)$).

[23]By assuming free entry and exit of firms, homogeneous goods, large no of buyers and sellers in the market, profit maximization motive and perfect mobility of factors of production.

[24]The value added (Y) demanded by industries is the combination of labor (L) and capital (K) and both are perfectly substitutable across activities. The elasticity of substitution is assuming 0.4 in current study.

Table 3. 2 Fundamental Relationship for CGE Modelling

		Institutional Sectors (1,…,h)					
		Commodities (1,…..n)	Primary Factors (1,…..f)	Private	Government	Rest of World	Capital Formation (1)
Institutional Sectors (1,…,h)	Commodities (1,…,n)	$B(x,p)$		$C(rd,p)$	$G(rd,p)$	$E(x,e)$	$I(p)$
	Primary Factors (1,…,f)	$Y(x,p_f)$					
	Private		$R^h(y)$	$T_r^h(y)$	$T_r^h(y)$	$T_r^h(y)$	
	Government	$Ta(x)$	$R^g(y)$	$T_r^g(y)$	$T_r^g(y)$	$T_r^g(y)$	
	Rest of World	$M(x,e)$	$R^{row}(y)$	$T_r^{row}(y)$	$T_r^{row}(y)$		
	Capital Formation (1)			$S^h(rd)$	$S^g(rd)$	$S^{row}(rd)$	$(+/-)a$

Source: Socci et al., (2018)

For more simplicity, we can express the above table 3.2 into the following identities.

$$B(x,p) + Y(x,p_f) + Ta(x) + M(x,e)$$
$$= B(x,p) + C(rd,p) + G(rd,p) + E(x,e) + I(p) \qquad [1]$$
$$R^h(y) + R^e(y) + R^{row}(y) = Y(x,p_f) \qquad [2]$$
$$C(rd,p) + T_r^h(y) + T_r^g(y) + T_r^{row}(y) + S^h(rd)$$
$$= R^h(y) + T_r^h(y) + T_r^h(y) + T_r^h(y) \qquad [3]$$
$$G(rd,p) + T_r^h(y) + T_r^g(y) + T_r^{row}(y) + S^g(rd)$$
$$= T_a(x) + R^g(y) + T_r^g(y) + T_r^g(y) + T_r^g(y) \qquad [4]$$
$$E(x,e) + T_r^h(y) + T_r^g(y) + S^{row}(rd)$$
$$= M(x) + R^{row}(y) + T_r^{row}(y) + T_r^{row}(y) \qquad [5]$$
$$I(p) = S^h(rd) + S^g(rd) + S^{row}(rd) \qquad [6]$$

The current study follows the rectangle FSAM, which is also known as a “MCM” - micro-consistency matrix and the construction of MCM is based on symmetric SAM. There are two types of symmetric forms SAM (commodities by commodities and industries by industries) used by researchers. Usually, MCM consists on both positive and negative entries. Positive and negative entries signify a receipt (sale) and expenditure (purchase) respectively in a particular market. The sum of rows and columns are zero in the framework of a rectangular MCM is “balanced” or “micro-consistent matrix”. Therefore, the positive numbers stand for the value of inside flow of commodities into the economy (sales or factor supplies). On the other hand, the negative values stand for the outside flow of commodities (demands or final demands) from economy. In the MCM framework, inside and outside flow of commodities in the economy is only balanced with each other when the rows sum would be zero. This implies on each commodity in the economy, which depicts the market clearance. The columns of MCM stand for production sectors or consumers and in other words if column sum is zero the value of outputs equals the cost of inputs. Usually, a consumer column is balanced if the value of final demand will be equal to sum of primary factor sales. Similarly, the terminology of zero profits or "product exhaustion" is also used in literature if the sum of columns will be zero. Some studies used MCM for their empirical analysis, e.g., (Fiorillo & Palomba, 2001; Rutherford & Light, 2001; Fiorillo & Socci, 2003; Socci, 2003; Ciaschini et al., 2004; Ciaschini et al., 2008; Ciaschini et al., 2014; Socci et al., 2015 and Ciaschini et al., 2016).

The current study is following the FSAM for Russia by using the latest available data sets of year 2015. As already explained the details of FSAM in chapter 2, FSAM for current FCGE analysis is based on four agents; firms, households, government, and rest of the world. Similarly, primary factors of distributions are consisted of four factors like compensation of employees, mixed income (sum of gross mixed income and gross operating surplus), and other taxes less subsidies. These primary factors making up the GVA, which is embedded with constant elasticity of substitution (CES) function, while the intermediate demand is based on Leontief linear system. The production process in the economy is distributed between domestic production supply and ROW (exports) by adopting the constant elasticity of transformation (CET) technology.

The domestic supply of each product is embedded with CET aggregation of domestic purchases and ROW (imports), which follows the Armington[25] hypothesis. However, the final demands come from households, government, rest of the world and investment.

[25]The main theme of Armington's hypothesis (1969) is that domestically produced commodities and imported commodities are not perfectly substitutes. There are three main advantages of Armington's: (i) it accounts for the large amount of cross-hauling (exports of same goods by two different countries) present in the data (imports and exports), (ii) it explains the clear empirical observations, and (iii) it allows the different degree of substitutions among different types of products and goods.

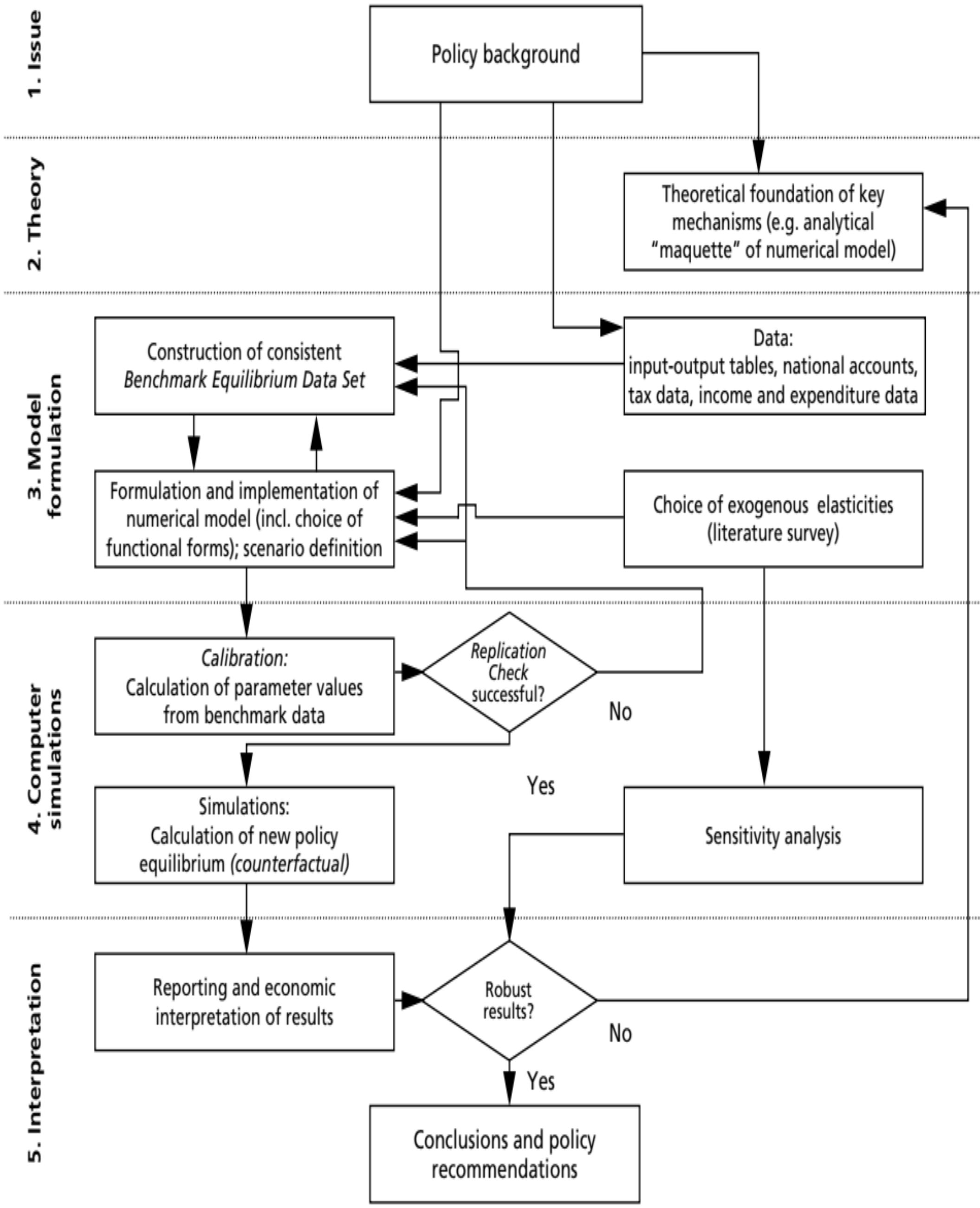
3.3.6 Estimation procedure of Computable General Equilibrium Modelling

The following figure 3.3 explains the general procedure of estimation for the CGE modelling in five steps. First, CGE modeler should construct the data set (Non-symmetric or symmetric SAM) and construction of model, which should be consistent with SAM. Second, CGE modeler should develop the theoretical framework of the study. Third, researcher needs to focus on data work, formulation of model, implementation, parameterization of functional forms, and policy analysis, if the policy outcomes will not appropriate then researcher should focus on the preparation of appropriate and consistent policy with the theoretical logics.

In the literature, the selection of parameter for estimation of CGE model is known as calibration, (see, Mansur et al., 1984). The calibration procedure usually requires one-year data of any particular economy, which is based on suitable exogenous elasticities and choice of elasticities can be estimated by researcher, some are selected arbitrarily or can choose from literature surveys[26]. As the nature of CGE modelling is deterministic, so the understood thing is that the calibration would be deterministic and does not allow any statistical test of the model specification. Finally, the results of CGE model should be consistent with economic theory and study should recommend the sound policy analysis.

[26] The researcher like Van der Werf, (2008) did excellent estimation of elasticities for different countries, https://ageconsearch.umn.edu/record/9549/files/wp070047.pdf

Figure 3. 3 General Procedure of Computable General Equilibrium Estimation



Source: (Böhringer et al., 2003)

3.4 METHODOLOGY

3.4.1 Static Computable General Equilibrium Model

The current study is following the Static Computable General Equilibrium (SCGE) and based on the assumption of competitive market. The objective of current study is to check the shock of final demand (shock in public investment) on macro variables (public level utility) of Russian economy, in other words, what would be changed in GDP, GVA. The model is based on 59 production sectors, three GVA components (compensation of employees, Mixed income including gross operating taxes and other taxes less subsidies on production), net taxes (taxes less subsidies on products), four institutional sectors (Firms (FC+NFC), Household (HH+NPISHs), Government and Rest of World (ROW)).

The study following the scheme of SAM has presented in table 2.4, which shows the circular flow of income and solution of model is based on the assumption of Walrasian equilibrium model. The Walrasian theory is based on the profit maximization by using the sets of prices and quantitates and by consideration of consumer utility in budget constraints. By considering the budget constraint, all market should be in equilibrium and fulfill the zero-profit condition. The zero-profit condition can be achieved whenever the price of goods will be equal to marginal cost of production and on the other hand, the value of input should be equal to value of output.

The market clearing conditions for goods and factors of production requires that by using all agents like prices, quantitates, supply and demand should be equilibrium. The equilibrium of commodities would be achieved whenever the total output should be equal to total demand. The total demand is consisted on (domestic demand) intermediate demand used for production process, demand for (households and NPISHs), demand for government purchases, demand for capital formation and exports. Similarly, the market clearing for primary factors will be fulfilled, when the factors endowments correspond to the primary factors demands expressed by the production system (Ciaschini et al., 2013).

The income budget constraint allows every institutional sector that the value of income equals the value of factors endowments and tax revenue. Therefore, the total endowments would be equal to consumption expenditure and savings for each institutional sector because firms and households' endowments are consisted on primary factor compensation plus the net transfers from others institutional sectors. On the other hand, Government endowment is consisted on total tax revenue plus the net transfers from institutional sectors.

The choice of functional form in CGE modelling is most important part and generally researchers adopt three types of functional[27] forms; (1) Leontief functions, (2) Cobb Douglas and (3) Constant Elasticity of substitution (CES),The CES[28] function has ability to calibrate the CGE model directly on benchmark deviations (Rutherford, 2002); (Klump & Saam, 2008) and (Sancho, 2009).The current study has adopted open-economy CGE model, which is based on CES functions and the related Constant Elasticity of Transformation (CET) functions are used to adjust the required preferences of trading (exports/imports) and domestic goods of consumers and producers in the economy. The trade between (export/import) and domestic goods are based on Armington[29]'s hypothesis.

The current study follows the Nested Production function based on CES assumption and framework of nested production function is given in Figure 3.4.

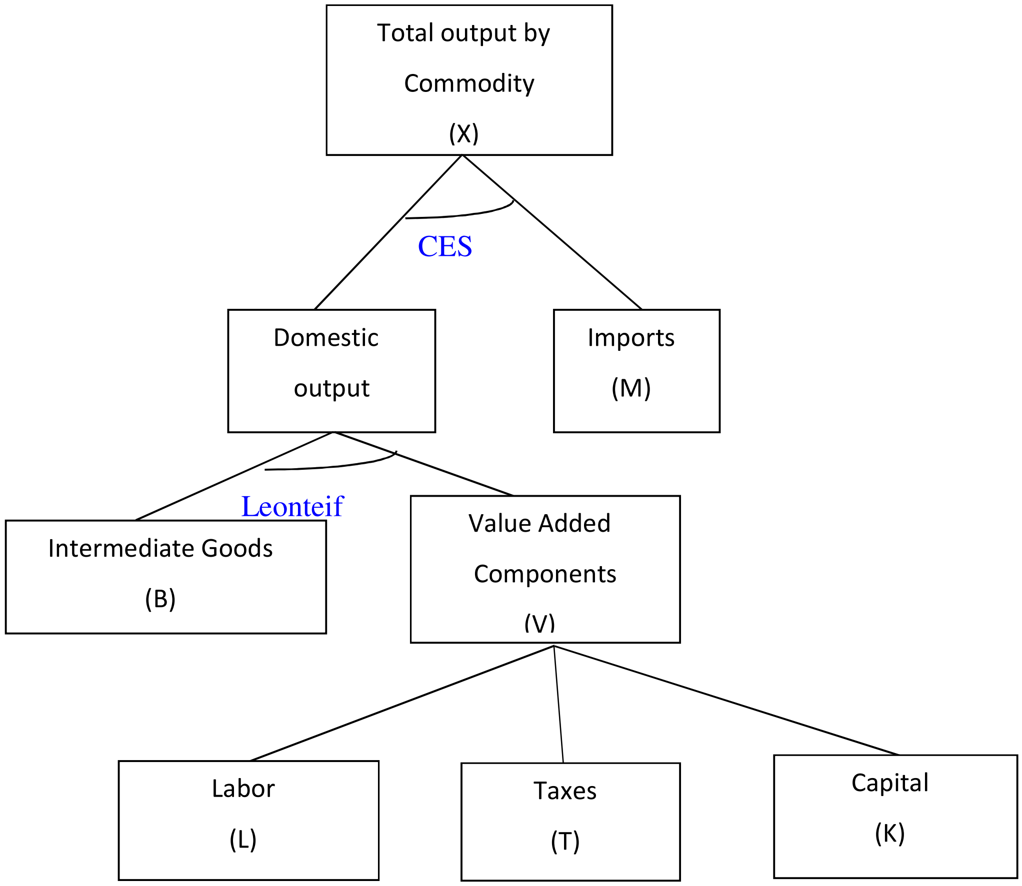
[27]There are different types of functional forms which have been explained by the study of (Böhringer et al., 2003).

[28]We can elaborate the general form of CES functional form as $y = \gamma\left(\sum_{i=1}^{n} \alpha_i x_i^{-\rho}\right)^{-\frac{1}{\rho}}$, where the term y is denoting output,x_i is input,$0 \leq \alpha_i \leq 1$ with $\sum_{i=1}^{n} \alpha_i$ is representing distribution parameter, where term $\gamma \geq 0$, represents the efficiency measurement, while the $\sigma = \frac{1}{1+\rho} \geq 0$ gives the elasticity of substitution and $\rho \geq -1$ must be fulfil, (See, Koesler & Schymura (2012), there are following general properties of CES function.

(1) homogenous of degree one,
(2) Can take number of parameters,
(3) non-decreasing function in x_j variables,
(4) concave with respect to the jthvariable,
(5) CES equals to $\rho = \frac{1}{1-\sigma}$ for each couple of (xi; xj),
(6) self-dual function can be used as production as well as cost function for profit maximizing firms.

[29] The main theme of Armington's hypothesis (1969) is that domestically produced commodities and imported commodities are not perfectly substitutes. There are three main advantages of Armington's: (i) it accounts for the large amount of cross-hauling (exports of same goods by two different countries) present in the data (imports and exports), (ii) it explains the clear empirical observations, and (iii) it allows the different degree of substitutions among different types of products and goods.

Figure 3. 4 Framework of Nested Production Function



The following function Y_j is being homogenous products produced by firms j and based on the assumption of factor substitution.

$$Y_j = F_j(x_{1j}, x_{2j}, \ldots\ldots, x_{kj}) \qquad [1]$$

In the above production function, the term Fj shows the homogeneous of degree of one, meaning that based on constant returns to scale, consistent with the assumption of perfect competition.

The parameters are unknown, and variables are adjusted according to available benchmark. The calibration process will be successful, when the researchers know the parameters and benchmark variables will be in balanced form. The CES cost function can be expressed as:

$$C(p, Y) = \frac{1}{\gamma}\left[\sum_i \alpha_i^{\sigma} p_i^{1-\sigma}\right]^{\frac{1}{1-\sigma}} Y \qquad [2]$$

Which can be extracted from the calibrated form of the production function:

$$\frac{Y}{\overline{\overline{Y}}} = \left[\sum_i \theta_i \left(\frac{X}{\overline{\overline{X_i}}}\right)^{\frac{1}{1-\sigma}}\right]^{\frac{\sigma}{1-\sigma}} \qquad [3]$$

$$c(p) = \overline{c(p)}\left[\sum_i \theta_i \left(\frac{p_{x,i}}{\overline{\overline{p_{x,i}}}}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \qquad [4]$$

Where, $\theta_i = \frac{\overline{p_i}}{c(p)}\frac{\overline{X_i}}{\overline{Y}}$

The prices of total output P_{X_i} can be expressed as given in equation [5].

$$P_{X_i} = \overline{P_{X_i}}\left[\frac{\overline{P_{Y_i}}}{\overline{\overline{P_{X_i} X_i}}}\frac{\overline{Y_i}}{\overline{\overline{X_i}}}\left(\frac{P_{Y_i}}{\overline{\overline{P_{Y_i}}}}\right)^{1-\sigma_{X_i}} + \frac{\overline{P_{M_i}}}{\overline{\overline{P_{X_i}}}}\frac{\overline{M_i}}{\overline{\overline{X_i}}}\left(\frac{P_{M_i}}{\overline{\overline{P_{M_i}}}}\right)^{1-\sigma_{X_i}}\right]^{\frac{1}{1-\sigma_{X_i}}} \qquad [5]$$

Where,

Variable	***Description***
X_i	Total output.
Y_i	domestic production.
M_i	Imports.
$\frac{\overline{P_{Y_i}}}{\overline{\overline{P_{X_i} X_i}}}\frac{\overline{Y_i}}{\overline{\overline{X_i}}}$	value share of domestic production w.r.t total output
$\frac{\overline{P_{M_i}}}{\overline{\overline{P_{X_i}}}}\frac{\overline{M_i}}{\overline{\overline{X_i}}}$	value share of imports w.r.t total output,
σ_{x_i}	Elasticity of substitution.
P_{X_i}	Final price of commodity.
P_{Y_i}	Price of domestic output.
P_{M_i}	Price of imported goods (fixed in imported currency).

The Leontief production function is given in equation [6], therefore the domestic output (Y) has nested with its two components like value added (VA) and intermediate goods (B). The elasticity of substitution is supposed to be zero ($\sigma = 0$).

$$Y = min\left[\frac{1}{q}.VA, \frac{1}{1-q}.B\right] \qquad [6]$$

By multiplication of prices and output, we get the following cost function given in equation [7].

$$PY = [qPVA + (1-q)PB] \qquad [7]$$

In the above equation the constant term q represents the value added input per unit, therefore P_{VA_i} and P_{B_i} are denoting the price indexes of value added and intermediate goods respectively and both prices are non-substitutable with each other.

$$C_B = \sum_n P_n q_n \qquad [8]$$

Where, $\sum_n q_n = 1, n = goods$

q_n term represents the "aggregate" input of intermediate goods.

The prices of domestic output can be expressed as in equation [9].

$$P_{y_i} = \frac{\overline{P_{VA_i}}\,\overline{Y_i}}{\overline{P_{y_i}}\,\overline{Y_i}}\left(\frac{P_{VA_i}}{\overline{P_{VA_i}}}\right) + \frac{\overline{P_{B_i}}\,\overline{B_i}}{\overline{P_{y_i}}\,\overline{Y_i}}\left(\frac{P_{B_i}}{\overline{P_{B_i}}}\right) \qquad [9]$$

Where, $\sigma = 0$

The decomposition form of value added price can be expressed as in equation [10], which is equal to summation of price of labor and capital.

$$P_{VA_i} = P_{L_i} + P_{K_i} \qquad [10]$$

Where, $i = L, K$

The cost functions for each primary factor (labor and capital) are elaborated as given in equation [11] to [13].

The equation [11] is denoting price of labor and similarly the equation [12] is representing the price of capital factor. The equation [13] is set of combination of equation [11] and [12].

$$P_{L_i} = \overline{P_{L_i}}\left[\frac{\overline{P_{L_i}}(1+t_{L_i})\overline{L_i}}{\overline{P_{L_i}L_i}}\left(\frac{P_{L_i}}{\overline{P_{L_i}}(1+t_{L_i})}\right)^{1-\sigma_{L_i}}\right]^{\frac{1}{1-\sigma_{L_i}}} \qquad [11]$$

$$P_{K_i} = \overline{P_{K_i}}\left[\frac{\overline{P_{K_i}}(1+t_K)\overline{K_i}}{\overline{P_{K_i}K_i}}\left(\frac{P_{K_i}}{\overline{P_{K_i}}(1+t_{K_i})}\right)\right]^{\frac{1}{1-\sigma_{K_i}}} \qquad [12]$$

$$P_{VA_i} = \overline{P_{VA_i}} \left[\frac{\overline{P_{L_i}}(1+t_L)\overline{L_i}}{\overline{P_{VA_i}VA}} \left(\frac{P_{L_i}}{\overline{P_{L_i}}(1+t_L)} \right)^{1-\sigma_{VA_i}} + \frac{\overline{P_{K_i}}(1+t_K)\overline{K_i}}{\overline{P_{VA_i}VA}} \left(\frac{P_{K_i}}{\overline{P_{K_i}}(1+t_K)} \right)^{1-\sigma_{VA_i}} \right]^{\frac{1}{1-\sigma_{VA_i}}} \quad [13]$$

Where,

Variable	***Description***
P_{VA_i}	Prices of factors (value added).
P_{L_i}	Prices of labor.
P_{K_i}	Prices of capital.
VA	Value added.
t_L	Tax rate on labor income.
t_K	Tax rate on capital income.
σ_{L_i}	Elasticity of substitution for labor.
σ_{K_i}	Elasticity of substitution for capital.
σ_{VA_i}	Elasticity of substitution for factors (labor & capital).

In the perfectly competitive market system, every consumer wants to maximize his utility by using his budget constraints and by calculating the number of initial endowments Wn and available choice of preference; we can get the consumer demand. The summation of all consumers' demand, we can get the market demand. However, the consumer demand is based on the assumption of consumer theory that demand of each consumer is based on prices, taste, are continuous, nonnegative and homogeneous of degree zero. The prices involved in demand are non-negative, so arbitrarily in the CGE model, we are assuming unitary prices.

$$\sum_{i=1}^{n} p_i = 1 \qquad [14]$$

The demand function is fulfilling the condition of Walras law, where the total value of consumer demand equals consumer endowments.

$$\sum_{i=1}^{n} p_i X_i\,(p_i) = \sum_{i=1}^{n} p_i X_i\, W_i \qquad [15]$$

Moreover, the Walras law says that the excess demand should be equal to zero at all prices.

$$\sum_{i=1}^{n} p_i (X_i\,(p_i) - W_i\ ) = 0 \qquad [16]$$

The demand function can be estimated by using the available benchmark and elasticity of substitution.

$$\frac{X_i}{\overline{X_i}} = \frac{Y}{\overline{Y}}\left[\frac{c_y}{\overline{c_y}}\frac{\overline{p_x}}{p_{x,i}}\right]^{\sigma} \qquad [17]$$

Where,

Variables	*Description*
Y	Output
X_i	Input Factor.
c_y	Output cost.
$p_{x,i}$	Price of input factor.
σ	Elasticity of substitution.

There are two trade-off options for consumers to use its disposable income, either consumer can use his resources today or can consume in future (savings), by using these options consumers can maximize its utility.

$$R_h = pu_h U_h \qquad [18]$$

In the above equation (18) where R_h represents net disposable income for the institutional Sector can be attained by multiplication of termU_h is the agent's utility and $pu_h$is the price index for utility.

$$maxU_h(C_h, S_h)s.v\ P_{c,h}C_h + P_h S_h = R_h \qquad [19]$$

Where,

Variables	*Description*
h	Institutional sectors
U_h	Utility
S_h	Saving
C_h	Final consumption
R_h	Income Level

$$U_h = \left[\sum \theta_h^C \left[\frac{C_h}{\overline{C_h}}\right]^{\frac{1-\sigma_{U_h}}{\sigma_{U_h}}} + (1-\theta_h^C)\left[\frac{S_h}{\overline{S_h}}\right]^{\frac{1-\sigma_{U_h}}{\sigma_{U_h}}}\right]^{\frac{\sigma_{U_h}}{1-\sigma_{U_h}}} \qquad [20]$$

$$P_{U,h} = \overline{P_{U,h}}\left[\sum_{n=1}^{59} \frac{\overline{PX_n}}{\overline{PU_h}}\frac{\overline{C_{n,h}}}{\overline{U_h}}\left(\frac{P_{TY_n}}{\overline{P_{TY_n}}}\right)^{1-\sigma_{u_h}} + \frac{\overline{P_{S_h}}\,\overline{S_h}}{\overline{P_{U_h}}\,\overline{U_h}}\left(\frac{P_{S_h}}{\overline{P_{S_h}}}\right)^{1-\sigma_{u_h}}\right]^{\frac{1}{1-\sigma_{U\,h}}} \qquad [21]$$

Demand function for saving is given below in equation [22].

$$S_h = \overline{S_h}\left[\frac{P_{U_h}}{\overline{P_{U_h}}}\frac{\overline{P_s}}{P_s}\right]^{\sigma_{S_h}} \qquad [22]$$

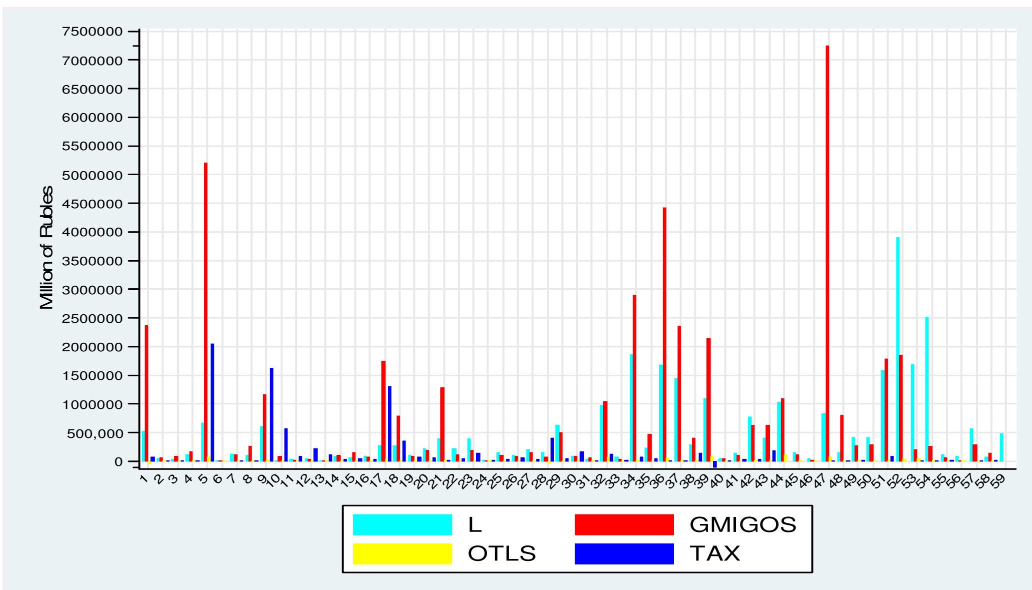
The distribution of consumption C_n among institutional sectors is presented w.r.t CES function.

$$\frac{C_n}{\overline{C_n}} = \frac{C}{\overline{C}} \left[\frac{P_C}{\overline{P_C}} \frac{\overline{P_{C_n}}}{P_{C_n}} \right]^{\sigma_C} \qquad [23]$$

3.4.2 Empirical Analysis of Fiscal Policy by using Static Computable General Equilibrium Model

First of all, we will represent the empirical results of SCGE model, where we have checked the shock of public investment for the Russian economy for year 2015. The following figure 3.5 depicts the trend of different components of GVA like compensation of employees (CE) in cyan color, mixed income including gross operating surplus in red color, other taxes less subsides on production in yellow color and net taxes less subsides on products with blue color. There is huge fluctuation has observed in gross mixed income including gross operating surplus with the maximum value of 723,972,6.63 million rubles in commodity no 47.

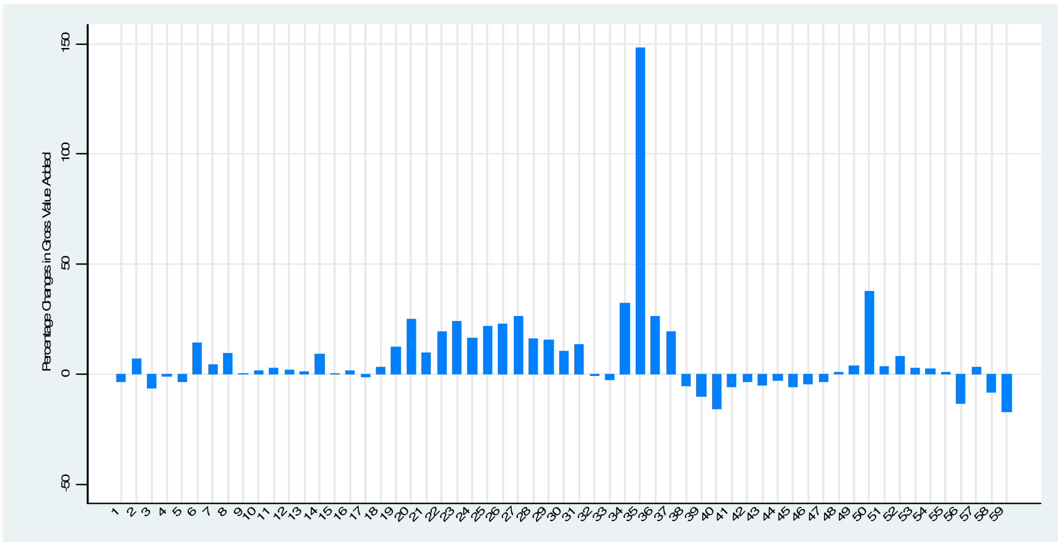
Figure 3. 5 Gross Value Added Components by Commodities



In policy scenario 1, we analyzed to check the impact of pubic investment shock on Russian economy by using SCGE and estimated the impact of public investment on different macroeconomic variables like GVA, percentage change in commodities price, percentage change in quantity of real goods. For this purpose, current study injected 1000 million rubles public investment that is used by the Government utility agent. There is 2.16% increase in aggregate GDP due to this public investment shock.

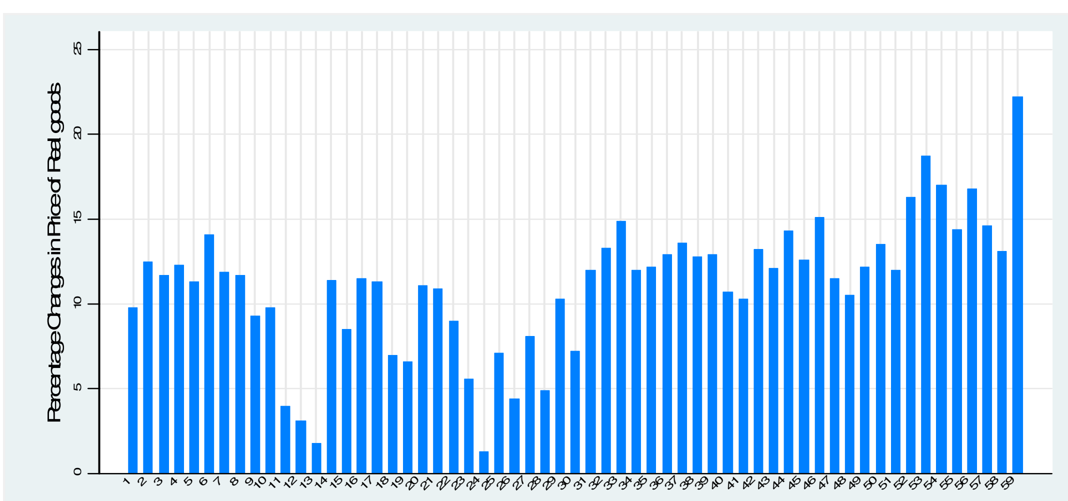
The following figure 3.6 depicts the percentage change in GVA by commodities. The blue bars are representing the fluctuation in GVA and most of bars are showing positive fluctuations. There is significant impact of simulation has been observed in commodity number 35 (Commercial vehicles and motorcycles, their maintenance and repair (without retail motor fuel)) with 148% change. Similarly, the commodity number 50 (Research and development) is showing the second highest fluctuation with 50% increase due to public investment shock. The detail of commodities is portrayed in appendix C-I (table 3.5).

Figure 3. 6 Percentage changes in Gross Value Added by Commodities



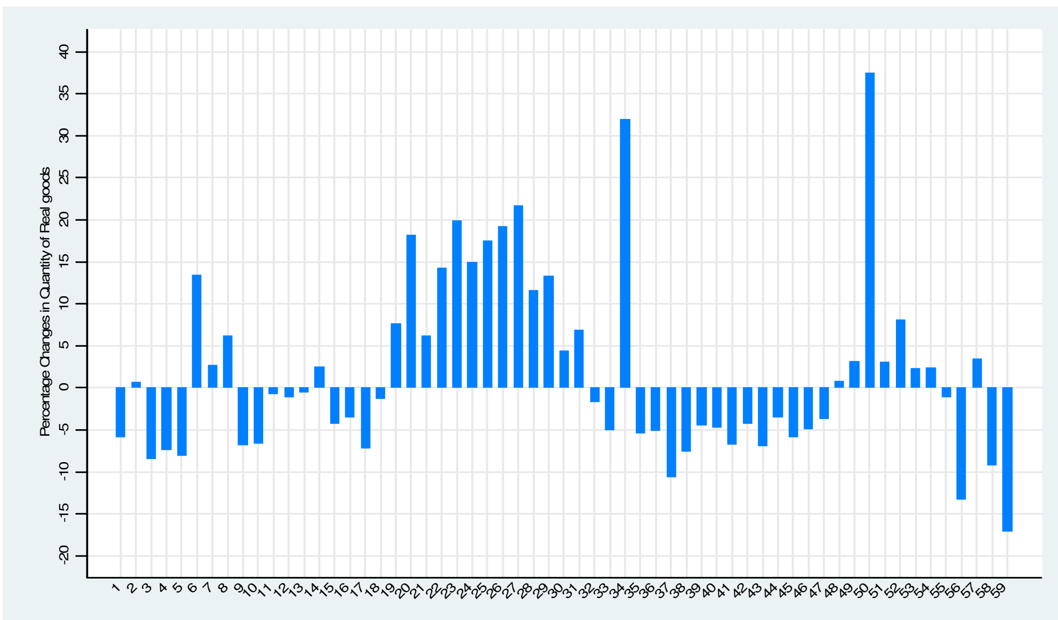
The following figure 3.7 depicts the change in the prices of real goods, the graph shows that all prices are showing positive trend. The smallest fluctuation is observed in commodity ‘24’ (Manufacture of office machinery and computers). However, almost all the price fluctuated less than 20% except of commodity ‘59’ (activity of household as employees) with the 22.20% fluctuation. The detail of commodities is portrayed in appendix C-I (table 3.5).

Figure 3. 7 Percentage changes in Price of Real Goods by Commodities



The figure 3.8 depicts the percentage changes in the quantity of real goods due to injection of public investment, the result shows the mixed results with both positive and negative fluctuations. The commodity number 50 (Research and development) shows highest positive fluctuations with 37.5% change. The commodity number 34 (Building) shows the second highest fluctuation with 32% change. On the other hand, the commodity numbers 59 (Activities of households as employers) and 56 (Activities of membership organizations) shows the negative fluctuation with -17.1% and -13.3% respectively. The detail of commodities is portrayed in appendix C-I (table 3.5).

Figure 3. 8 Percentage changes in Quantity of Real Goods



3.4.3 Dynamic Computable General Equilibrium Model

There are two versions of dynamic models, which have been built by researchers. First type of models is based adaptive expectations and second type of models allows rational expectations. Further, the DCGE model based on rational expectations can also be divided into two types: a) Ramsey model, and b) overlapping-generations model (OLG). The study of (Lau et al., 2002) is based on famous Ramsey[30] Growth Model and explained infinite Horizon equilibria with endogenous capital formation. The optimization problem for all consumers has been explained by the following mathematical expressions by the studies of (Ciaschiniet al., 2014) and (Ciaschini et al., 2016). The current study is following the Mixed Complementary problem (MCP) by using the GAMS[31] software; the MCP has capability to solve the linear as well as non-linear equations. The researcher like Thomas Rutherford (1999) designed the programming of MPSGE (*Mathematical Programming System for General Equilibrium Analysis*) in early 80s for solving the Arrow-Debreu economic equilibrium models. The current study is following the consistency of SAM and CGE modelling by following the (Paltsev, 2004)[32].

The algebraic mathematical equations for DCGE have been explained in following notations.

$$\max \sum_{t=0}^{T} \left(\frac{1}{1+\rho}\right)^{t} U^{l}[C_t^l] \qquad [25]$$

s.t.

$$C_t^l = \xi_l(x[K_t^j, L_t^j, M_t^j, T_t^j] - B_t^j - I_t^j - E_t^j) \qquad [26]$$

$$K_{t+1}^j = (1-\delta^j)K_t^j + I_t^j \qquad [27]$$

Where terms t and T represents the time and terminal periods respectively,ρ is the individual time-preference parameter, U^l is depicting the utility function, institutional sectors are representing by the $l = 1, \ldots\ldots, i$, the commodities $j = 1, \ldots\ldots, m$, the term C_t^l is depicting the consumption of each institutional sector in each time period, the term ξ_l represents the share of consumption w.r.t institutional sector.

The first order conditions deriving from this maximization problem are:

[30] Ramsey, F. P. (1928). A mathematical theory of saving. *The economic journal*, *38*(152), 543-559.

[31] General Algebraic Modelling Software also called GAMS (See, Keyzer 1997; Löfgren et al. 2002, and Hosoe et al. 2004).

[32] http://www.gamsworld.org/mpsge/debreu/papers/move.pdf

$$P_t^j = \sum_l \xi_l \cdot \left(\frac{1}{1+\rho}\right)^t \cdot \frac{\delta u(C_t^l)}{\delta C_t^l} \qquad [28]$$

$$PK_t^j = (1-\delta)PK_{t+1}^j + P_t^j \cdot \frac{\delta x\left(K_t^j, L_t^j, M_t^j, T_{at}\right)}{\delta K_t^j} \qquad [29]$$

$$P_t^j = PK_{t+1}^j \qquad [30]$$

Where P_t^j is the price of output, $PK_t^j$is the price of capital paid by each sector. The condition of markets, profits and budget constraint under the context of MCP can be formulated algebraically.

The equations [31] to [34] depicting the Market clearing conditions holds for all commodities and primary factors markets. These conditions posit that the value of excess demand is always non-positive. That the total supply is equal to the total demand of each good and primary factor only for a certain positive price determined by the solution of the problem. Then the corresponding mixed complimentary problem can be expressed as follows:

Market clearing conditions:

$$X_t^j \geq B_t^j + \sum_l C_t^l\,(P_t^j, RA^l) + I_t^j + E_t^j \perp P_t^j \geq 0, P_t^j\,(X_t^j - B_t^j - \sum_l C_t^l\,(P_t^j, RA^l) - I_t^j - E_t^j) = 0 \quad [31]$$

$$L_t \geq \sum_j X_t^j \frac{\delta x(RK_t^j, PL_t, PM_t^j, Ta_t^j)}{\delta PL_t} \perp PL_t \geq 0, PL_t(L_t - \sum_j X_t^j \frac{\delta x(RK_t, PL_t, PM_t^j, Ta_t^j)}{\delta PL_t} = 0 \qquad [32]$$

$$K_t \geq \sum_j X_t^j \frac{\delta x(RK_t^j, PL_t, PM_t^j, Ta_t^j)}{\delta RK_t} \perp RK_t \geq 0, RK_t(K_t - \sum_j X_t^j \frac{\delta x(RK_t, PL_t, PM_t^j, Ta_t^j)}{\delta RK_t} = 0 \quad [33]$$

$$M_t^j \geq X_t^j \frac{\delta x(RK_t^j, PL_t, PM_t^j, Ta_t^j)}{\delta PM_t^j} \perp PM_t^j \geq 0, PM_t^j(K_t - X_t^j \frac{\delta x(RK_t, PL_t, PM_t^j, Ta_t^j)}{\delta PM_t^j} = 0 \qquad [34]$$

Where $RA^l$is the consumers disposable income, RK_t is the rental of capital, PL_t is the wage and PM_t^j is the price of imported goods.

Similarly, for financial commodities we have:

$$SL_t^f \geq A_t^f \perp P_t^f \geq 0, P_t^f\left(SL_t^f - A_t^f\right) = 0 \qquad [35]$$

$$with A_t^f = \sum_l a_f^l \left(P_t^f, S_t^l\right) \qquad [36]$$

Where, P_t^f is the price of financial output and a_l is the demand function of financial instruments by each institutional sector. The terms A_t^f and L_t^f are denoting assets and liabilities financial instruments, respectively.

The condition on profits postulates that total supply in each commodity market is determined by the perfect competitive market condition, price equals average total cost (fulfilling the zero-profit condition). In a general equilibrium model, the price that clears the market (demand equals to supply) also equals average total costs for each commodity. Analytically we have:

$$PK_t \geq RK_t + (1-\delta)PK_{t+1}, K_t \geq 0, K_t(PK_t - RK_t - (1-\delta)PK_{t+1} = 0 \qquad [37]$$

$$AC^j(RK_t^j, PL_t, PM_t^j, Ta_t^j) \geq P_t^j, X_t^j \geq 0, X_t^j(AC^j(RK_t, PL_t, PM_t^j, Ta_t^j) - P_t^j) = 0 \qquad [38]$$

Income balance conditions derive from the budget constraint:

$$RA^l = PK_0 K_0^l + \sum_{t=0}^{T}(PL_t + PM_t^j M_t^{lj} - Ta_t^j) - PK_{T+1}K_{T+1}^l \qquad [39]$$

The detail description of used parameters and variables (endogenous and exogeneous) in current study is presented in the following table 3.3.

Table 3. 3 Description of used Parameters and variables in DCGE Modelling

Parameters	***Description***
t	Time periods
T	Terminal period
ρ	Individual time-preference parameter
δ	Capital depreciation rate
g	Growth rate
r	Interest rate
j	Commodities
ξ_l	Share of consumption by institutional sectors
l	Institutional sectors (Firms, Government, Households and ROW)
f	Financial instruments
$\boldsymbol{U_0^l}$	Utility w.r.t institutional sectors in the benchmark

Table 3.3 (Continue)

Parameters	Description
C_0^l	Consumption w.r.t institutional sectors in the benchmark
I_0	Investment in the benchmark
L_0	Supply and demand of Labor in the benchmark
KS_0	Initial stock of capital
L_0^l	Labor endowment w.r.t institutional sectors in the benchmark
K_0^l	Capital endowment w.r.t institutional sectors in the benchmark
X_0^l	Total output by commodity in the benchmark
M_0	Imports in the benchmark
B_0^j	Intermediate consumption in the benchmark
VA_0^j	Value added in the benchmark
T_a^j	tax rate on output
T_a^l	Income tax rate w.r.t institutional sectors
Endogenous Variables	**Description**
I_t	Investment in period t
C_t^l	Consumption w.r.t institutional sectors in period t
S_t^l	Savings w.r.t institutional sectors in period t
U^l	Intertemporal Utility function w.r.t institutional sectors
X_t^j	Total output by commodity in period t
K_t	Capital demand in period t
L_t	Labor demand in period t
M_t^j	Imports w.r.t commodities in period t
T_{at}	All taxes payed by sectors in period t
A_t^j	Assets (demand of financial instruments in period t)
L_t^j	Liabilities (supply of financial instruments in period t)
AC^j	Average cost function
P_t^j	Price of commodities in period t
Pf_t	Price of financial instruments in period t
PK_t	Price of capital in period t
RK_t	Rental of capital in period t
PL_t	Wage in period t
PM_t	Price of imports in period t
RA^l	Intertemporal disposable income w.r.t institutional sectors
KS_t	Capital stock in period t
Exogenous Variables	***Description***
E_t^j	Exports w.r.t commodities in period t

PM_t^j	Price of imports in period t
P_t	Price of output in period t
σ_{LK}	Elasticities of substitution between labor and capital
σ_M	Elasticities of substitution between domestic goods and imports

The DCGE model is based on inter temporal utility function, which is depending upon the final consumption expenditure and saving with subject to budget constraint. In this study, the capital accumulation required the condition, where the capital stock in period t+1 should be equal to capital stock in period t (K_t) less depreciation (δK_t) plus gross fixed capital formation in period t (I_t)[33].

The most important aspect of FCGE is equilibrium in financial market, where both assets and liabilities instruments (the detail view of financial instruments are presented in appendix C-II, table 3.6) should be equal to each. In other words, the financial commodities should be balance in a way where the total demand for each instrument on assets (A_t) and the total supply of financial instruments liabilities (SL_t).

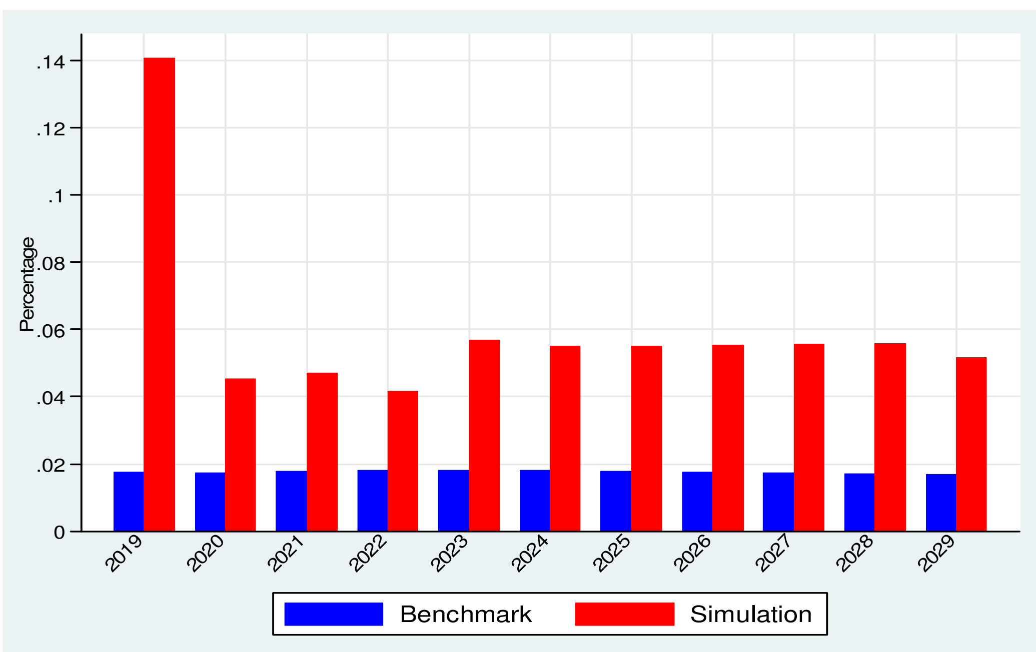
[33]The steady state condition of Investment is fulfilling with equation, $\boldsymbol{I_t = (\delta + g)K_t}$. Where **g** is real growth rate and current study is considering g=2% for Russian economy. The value δ is calibrated on SAM benchmark and calculated the $\delta = \frac{(g*K^0 - r*I^0)}{I^0 - K^0}$. The term r is representing the nominal interest rate and the current study considering r=5%.

3.4.4 Empirical Analysis of Monetary Policy by using Dynamic Computable General Equilibrium Model

The policy scenario 2 is based on DCGE, where we want to check the impact of increase in supply of money in the form of bond purchased under instrument of "currency and deposits", which will ultimately increase in the demand of assets for Central Bank. The current study has investigated the impact of policy in terms of GDP in percentage variations from benchmark, GVA, (quantities and prices) of real and financial commodities. For this analysis, the current study injected 10 thousand million rubles in economy, which ultimately will increase the assets of central block in the form of bonds etc. The Financial Social Accounting Matrix is the best tool to capture impact of circulation of money purchases and stimulates the whole circular flow of income for Russian economy. The current study forecasted this analysis for 11 years and taken the year 2019 as benchmark year.

The following figure 3.9 presents the change in GDP in terms of percentage. The result shows that there is huge fluctuation in year 2019, the red bar (simulated result) shows around about 14% growth rate. In all other years, the simulated GDP growth rate (shown in red bars) is higher than benchmark GDP growth rate (shown in blue bars). In most of years the growth rate is fluctuating between 2% to 5%.

Figure 3. 9 Percentage change in GDP from benchmark



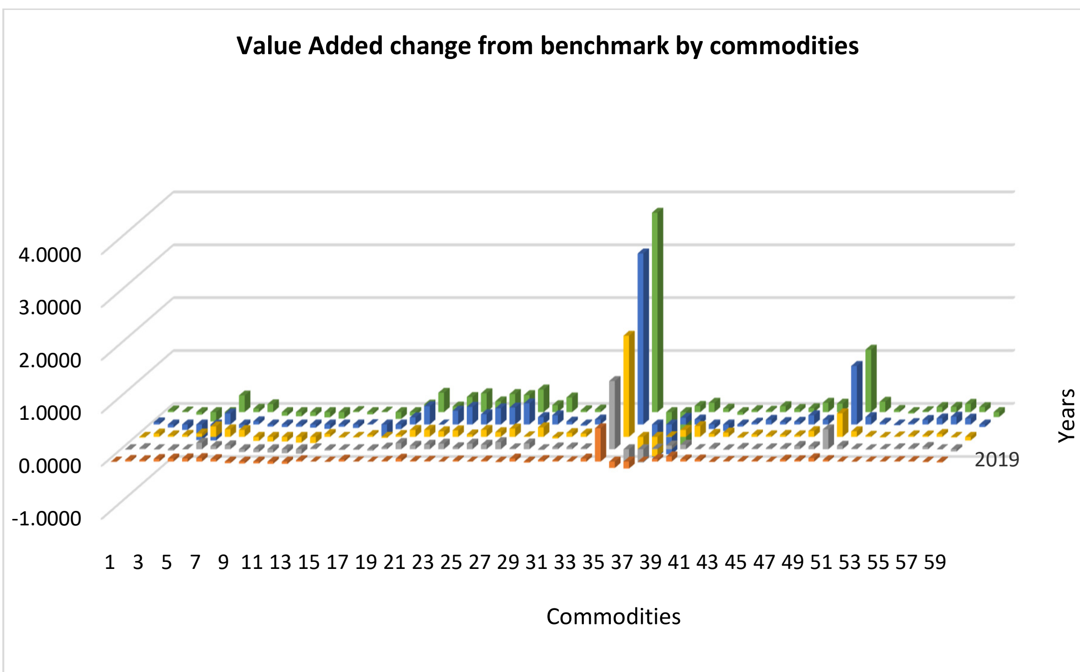
The table 3.4 given below portrayed the percentage variation in GDP with respect to benchmark. The result shows that there is huge fluctuation has been observed in year 2020 with 14.1% and on the other hand in year 2023, there is low fluctuation has been observed with 4.2% change.

Table 3. 4 Percentage change in main Gross Domestic Product from 2020 to 2029

Years	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
GDP	14.1%	4.5%	4.7%	4.2%	5.7%	5.5%	5.5%	5.5%	5.6%	5.6%

The figure 3.10 explains the 3D view of GVA variation on commodity. There are two types of values which are portrayed here in the following figures. The positive values mean that the simulated GVA are higher than benchmark and on other hand, the negative values depict that the simulated GVA is lower than the benchmark gross value added. The high level of bars is representing the significant impact of supply of money on GVA by commodities.

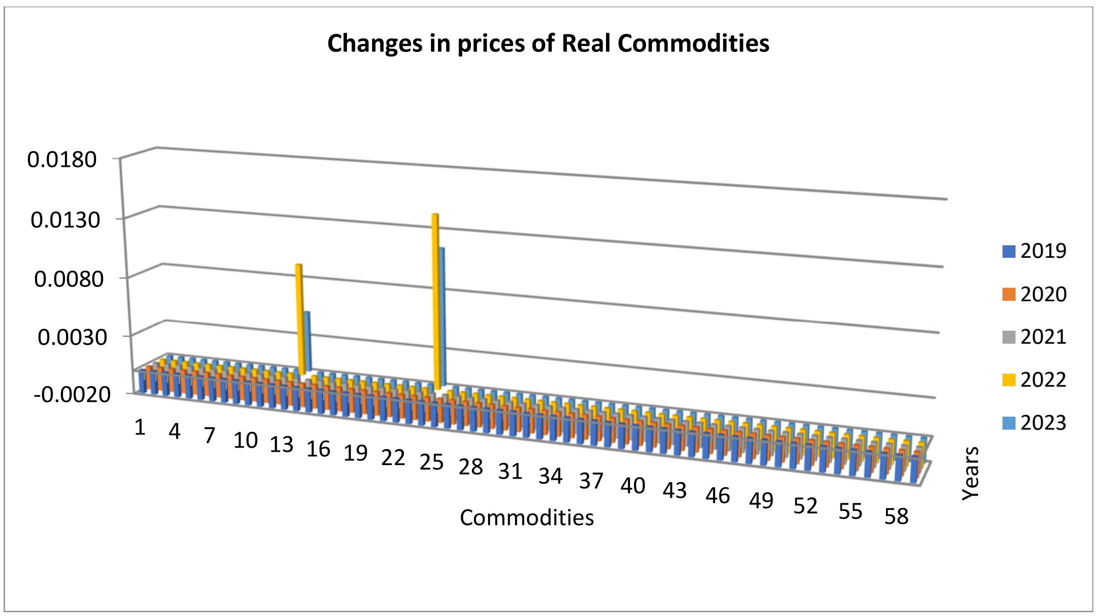
Figure 3. 10 Percentage change in Gross Value added from benchmark



Therefore, analogical view of GDP and GVA depicts that the results of figure 3.10 is also consistent with the previous studies which shows the directly proportional relationship between the injection of money and GDP as well as GVA and vice versa. The view of figure 3.10 also shows that policy makers identify the most sensitive components of GVA by commodities.

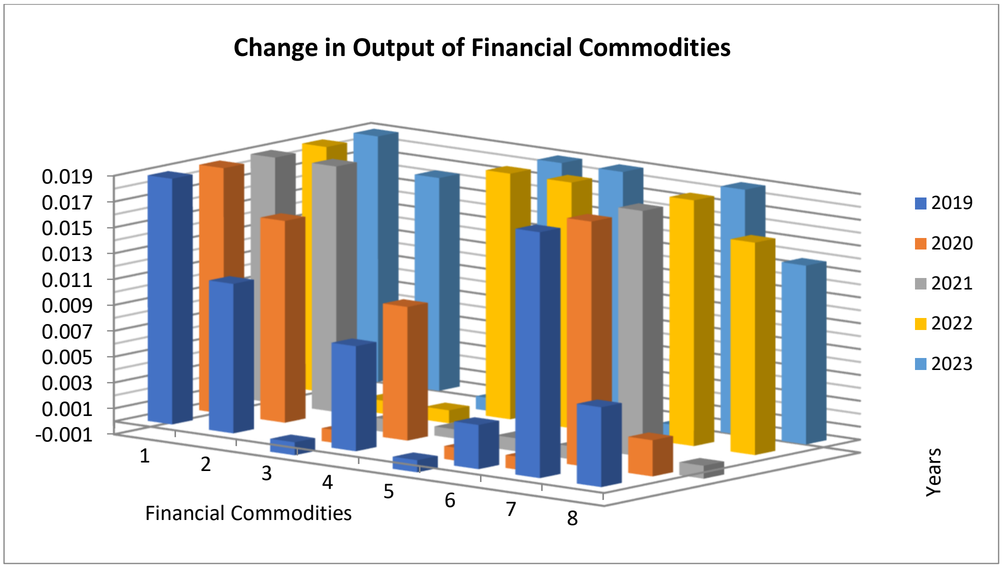
The following figure 3.11 depicts the disaggregated fluctuations in the price of real commodities from year 2019 to 2023. The result shows the before and after simulated price of commodities. There is very low level of fluctuation in the prices of real commodities between the benchmark and simulated prices. The higher level of price fluctuation is just 0.42% in whole span of time from year 2019 to 2023. Moreover, most of the prices of some commodities are negative and low as compared to the benchmark. Only in commodity '1' (agriculture and hunting activity) is showing huge level of positive fluctuated price in the figure 3.11.

Figure 3. 11 Percentage change in Commodities price from the benchmark



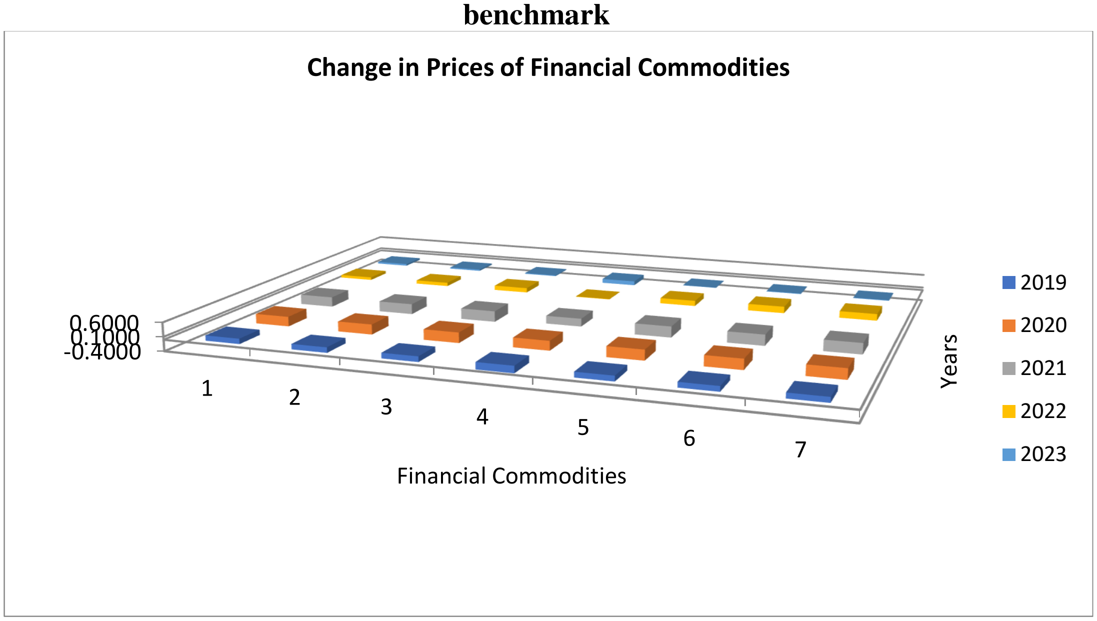
The figure 3.12 depicts the price variation in the financial commodities and result shows that there are significant positive variations in the price of financial commodities. These results are consistent with the previous studies findings that the increase in money supply leads to the sustained increase of commodity prices (Bordo & Rockoff 2013; Friedman & Schwartz, 1963 a & b).

Figure 3. 12 Percentage change in output of Financial commodities from the benchmark



The figure 3.13 depicts the disaggregated fluctuations in the price of financial commodities from year 2019 to 2023. The result shows the before and after simulated price of commodities. There is very low level of fluctuation in the prices of financial commodities between the benchmark and simulated prices. The higher level of price fluctuation is just 0.24% in whole span of time from year 2019 to 2023. Moreover, most of the prices of some commodities are negative and low as compared to the benchmark.

Figure 3. 13 Percentage change in price of Financial commodities from the benchmark



3.5 CONCLUSION

This study aims at contributing to the existing literature in several ways. First, it analyzed the impact of public investment on Russian economy by using the Static CGE model and analyzed the impact of public investment injection on macro variables like GDP, GVA, change in commodities price, and change in quantity of real goods. The SCGE analysis finds the significant impact of public investment injection on macro economy of Russia for year 2015. Second, the study develops the first financial SAM for the Russian economy for the year 2015.Third, constructed first financial CGE model for Russia by taking 11 years' time span from 2019 to 2029, which is the best combination and representation of inter-relationship of real and financial economic variables. Fourth, significant contribution in the existing literature on mutual analysis of real economic as well as financial economic policies. Fifth, the study has developed and calibrated the financial dynamic CGE model to investigate the impact of monetary policy on macroeconomic variable like GDP, GVA, prices of real and financial commodities and quantities of real and financial goods in percentage terms. The findings of our study confirm the significant impact of monetary policy on the macroeconomic variables like GDP, GVA prices of real and financial commodities, and quantities of real and financial goods. Further, there is huge potential to formulate the different (expansionary and contractionary) fiscal as well as monetary policies by using the current developed financial SAM for Russia.

The first policy recommendation of current study is that the there is need to explore the different sectors of economy (export diversification) and should be reduce the dependence of the Russian economy on energy resources, including oil. Second, there is need to transform the Russian economy from industrial to innovative. Third, there is requirement to take step for the improvement of the investment climate in the country for a foreign investor. As, we observed that there is very significant impact to injection of investment in the Russian economy and all key macro variables GDP, GVA and prices of real and financial commodities and quantity of real as well as financial commodities are increasing with respect to time. Which is further helpful to tackle the problem of fiscal deficit in the Russian economy and can provide the sufficient amount Government spending for development of economy. Fourth, there is need to choose the appropriate monetary policy (open market operation) for adjusting the required level of supply of money in the economy to maintain the interest rate. The appropriate level of interest rate will lead to increase the investment, aggregate demand and production level in the oil exporting country like Russia.

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Appendix C-I

Table 3. 5 Classifications of Industries for Russian Economy

No	Industries Code	Description of Commodities and Industries
1	01	Agriculture, hunting and rendering of services in these areas
2	02	Forestry, logging and related service areas
3	05	Fishing, fish farming and related service activities
4	10	Mining of coal, lignite and peat
5	11	Crude oil and natural gas; rendering of services in these areas
6	12	Mining of uranium and thorium ores
7	13	Mining of metal ores
8	14	Other mining and quarrying
9	15	Manufacture of food products and beverages
10	16	Production of tobacco
11	17	Textiles
12	18	Manufacture of wearing apparel; dressing and dyeing of fur
13	19	Manufacture of leather, leather products and footwear
14	20	Processing of wood and of products of wood and cork, except furniture
15	21	cellulose, wood pulp, paper, cardboard and their products
16	22	Publishing printing and reproduction of recorded media
17	23 *	Coke production; petroleum products
18	24 *	Chemical production (excluding production of gunpowder and explosives)
19	25	Rubber and plastic articles
20	26	Other non-metallic mineral products
21	27	metallurgical industry
22	28	Manufacture of fabricated metal products

23	29 *	Manufacture of machinery and equipment (excluding the production of weapons and ammunition)
24	30	Manufacture of office machinery and computers
25	31	Manufacture of electrical machinery and apparatus without the production of insulated wires and cables
26	32	Manufacture of electronic components, equipment for radio, television and communication
27	33	Production of medical products; measuring means, control, monitoring and testing; optical instruments, photographic and film equipment; hours
28	34	Manufacture of motor vehicles, trailers and semi-trailers
29	35 *	Production of ships, aircraft and spacecraft and other vehicles; Manufacture of other products of mechanical engineering and petrochemistry
30	36	Production of furniture and other goods not included in other categories
31	37	Processing of secondary raw materials
32	40	Production, transmission and distribution of electricity, gas, steam and hot water
33	41	Collection, purification and distribution of water
34	45	Building
35	50*	Commercial vehicles and motorcycles, their maintenance and repair (without retail motor fuel)
36	51	Wholesale trade and commission trade, except of motor vehicles and motorcycles
37	52 *	Retail trade, except of motor vehicles and motorcycles; repair of household goods and personal items; retail sale of automotive fuel
38	55	Activity of hotels and restaurants
39	60	Land transport activities
40	61	Water transport
41	62	Activity of air and space transport
42	63	Supporting and auxiliary transport activities
43	64	link
44	65	financial intermediation
45	66	Insurance
46	67	Activities auxiliary to financial intermediation and insurance

47	70	Real estate activities
48	71	Renting of machinery and equipment without operator; rental of household goods and personal items
49	72	Activities related to the usage of computers and information technology
50	73	Research and development
51	74	Other service activities
52	75	Public administration and defense; social insurance
53	80	Education
54	85	Health care and social services
55	90	Wastewater collection wastes disposal and similar activities
56	91	Activities of membership organizations
57	92	Activities, recreation and entertainment, culture and sport
58	93	Personal services
59	95	Activities of households as employers

Appendix C-II

Table 3. 6 Financial Accounts with respect to Financial Assets and Liabilities

Sr.	***Financial Instruments***
1	Monetary gold and SDRs
2	Currency and deposits
3	Debt Securities
4	Credits and Loans
5	Shares and other Equity
6	Insurances and pensions reserves
7	Receivables